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February 15, 1934

Pier Construction in a 28-Ft. Tide at a Canadian Ocean Port

Structure of unusual design involving gravity section walls on concrete arches in turn supported by piers resting on rock was built at St. John, N. B., within a 43-acre cofferdam which failed twice under the force of high tides.

Fundamental Research on Cement-Macadam Roads

Sewerage System Utilized for Garbage Disposal

Current Research at Lehigh University

Annual Meeting of Associated General Contractors

Protection from Corrosive "DRIPPINGS"

WITH all the evidence on wrought iron's ability to resist corrosion so readily available, it's no wonder that bridge engineers are giving it an important job in new construction.

Illustrated here is an application of wrought iron plates in bridge construction where, with a less durable material, maintenance would be difficult and costly. The deck plates on this Missouri Pacific ballast type bridge at Little Rock are of Byers Wrought Iron, 5/8" thick, welded together to form a watertight corrosion-resisting covering for the floor members. It was found that the use of a wrought iron deck permitted the reduction of floor depth to a minimum, which in this case meant a saving of 8".

The need for wrought iron in structures exposed to brine drippings and locomotive blasts is obvious. Maintenance figures tell the story. Evidence that wrought iron can do the job is its long record in corrosive service on both land and sea—especially in the presence of salt water and corrosive atmosphere. Even now, there are many all-wrought-iron bridges still in service after 40, 50, 60 and more years.

Bridge construction and maintenance work today includes more wrought iron specifications than before. What about your next blast plate, cover plate, trough plate, water trough or bridge railing job? We have, readily available, a wealth of information on wrought iron's long record in bridge service, engineering data and photos of recent installations. Ask a Byers Engineer or write our Engineering Service Department.

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W. W. De Berard
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In the News:

NO MORE APPLICATIONS for loans to municipalities are to be sought by the Public Works Administration. With no new funds available for allotment, the PWA feels that states, counties and municipalities should not be put to the expense of preparing applications until there is a better chance of getting a loan. Although allotments of all the three-billion-dollar fund have been made, the PWA is rescinding many allotments that now have little or no chance of being approved. In this way the PWA is able to produce funds to re-allot in order to satisfy loan applications that it has in hand.

NEW PROBLEMS are put up to the maintenance-of-way engineers of the railroads by high-speed trains such as the three-section streamlined unit just completed for the Union Pacific Ry. In a demonstration on Feb. 12 it is reported to have made 84 m.p.h.; its maximum speed is said to be 110 m.p.h. Such speeds will call for new refinements in line and surface if riding comfort is to be maintained.

PREQUALIFICATION of contractors has been held by a local court at St. Paul, Minn. to invalidate a paving contract because the prequalification requirements set up by the highway department stifled competition. The department required that bids be submitted only by contractors who previously had done large paving jobs for the state. And having declared the contracts void the court set about to determine the fair price for the actual work done and found it to be about 20 per cent below the total contract price.

BIDS on part of the Coachella tunnel work on the Colorado River Aqueduct have been rejected because all were above the engineers' estimates. This is not the only instance of such action in recent months. It raises question as to whether engineers in making their estimates are giving due weight to the bidding factors that the contractor faces at the present time, including wage uncertainties and rising material prices.

ENGINEERS of the Port of New York Authority who directed the construction of the great George Washington Bridge over the Hudson River at New York are to direct the completion of the Triborough Bridge at New York, including the main suspension span over Hell Gate.

In This Issue:

CONSTRUCTION of large new piers in the harbor at St. John, N. B., in progress during the past five years, is nearing completion. The piers themselves are notable structures, and construction of them has been complicated by the abnormal tide range in the St. John harbor. Details of both the structures and of the methods employed in building them are recorded in the leading artcile in this issue.

THE SUMMER PEAK LOAD of garbage disposal at Baltimore is taken care of by grinding the garbage to a pulp and dumping it into the sewers to be digested in the sewage-disposal plant along with the solids in the sewage. Mr. C. E. Keefer describes the way in which this was done last year without detriment to the sewage-disposal plant and at a considerable saving over adding to the incinerator capacity.

THE CURRENT WORK in the many research laboratories of the colleges is too seldom widely known. To give engineers a knowledge of what researches are under way, it is planned to publish periodic notes concerning the more active laboratories. The first series of notes, on the Fritz Engineering Laboratory at Lehigh University, appears in this issue.

APPROVAL of the construction industry code and imminence of approval of the general contractors' chapter of that code have put major administrative problems before the Associated General Contractors of America. How the organization plans to meet these problems is outlined in the report of the association's annual meeting in Washington.

FUNDAMENTAL RESEARCH into cement-macadam road construction was carried on last summer by the Portland Cement Association. Since this method of pavement construction was revived in this country about two years ago, methods of construction have been developed largely from accumulated field experience. The P.C.A. research recorded in this issue, is therefore, an important contribution to the art of roadbuilding as it is directed toward developing rational methods of control for this type of pavement.

Coming Articles:

FROM THE STANDPOINT of size, cost, complexity and the remarkable feature of placing a suspension-bridge anchorage in the middle of deep channel waters, the San Francisco-Oakland crossing construction is the most ambitious bridge-building enterprise yet undertaken. The chain of events that led up to its development is equally remarkable. The men in charge of the work believe that for this reason an authoritative series of accounts of the undertaking is necessary for adequate engineering information. The first article of this series, outlining the development of the project and the final solution of the great problem presented, will appear in *Engineering News-Record* within a few weeks. It will shortly be followed by a technical study of the foundation problem —piers sunk to unprecedented depths by processes representing notable advance over previous methods.

Cold-Weather Concreting Methods Push Projects Ahead

With Most Winter Construction Problems Solved, Contractors and Engineers Know Sources of Special Advice for Puzzlers

PRODDED by the need for going ahead with projects in coldest weather this winter, contractors in most of the country north of the Mason-Dixon line are tussling again with Old Man Winter and those tough twins of his —Freezing and Thawing.

Effective Tricks

That near-zero temperature plays havoc with freshly placed concrete, insufficiently protected, is a thoroughly established fact. However, contractors, not easily discouraged, have learned effective tricks of their own since the days when the first blasts of cold weather drove reputedly hard-boiled old-timers indoors to sit with folded hands by the fire. Heating mixing water and aggregates, tarpaulin and straw protection of fresh concrete, complete or partial inclosure of structures, strategic use of steam or salamanders—these are some of the workable methods which, if followed, produce quality concrete under even the worst cold weather conditions.

Special Problems

Still, now and then, there are special jobs of winter concreting that raise bothersome problems. To quickly and conveniently get helpful information on these, construction men are often turning to those whose special job it is to know concrete from A to Izzard—the cement people.

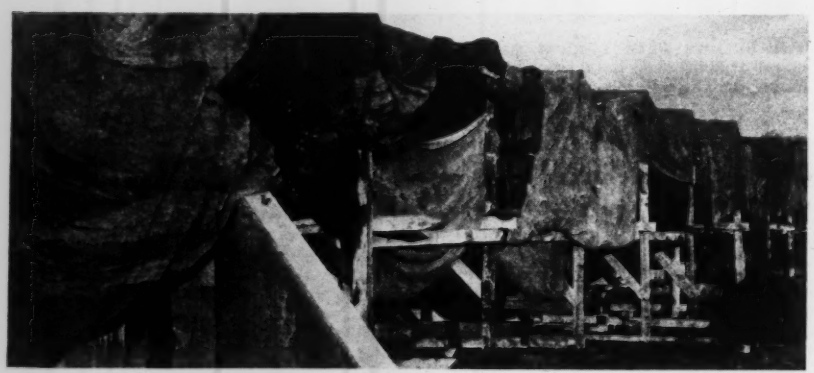
Builders who have written to the Universal Atlas Cement Co. for example, to get advice on some project hampered by freezing weather, have found that an early mail brings comprehensive, directly helpful information on cold-weather concreting. Backed by such information and their own hard-won experience, they have licked Old Man Winter more times than he likes to tell, in getting concrete mixed, placed and cured *right*, regardless of nasty weather and stubborn jobs.

. . . tussling again with Old Man Winter and those tough twins of his—Freezing and Thawing, contractors go ahead in coldest weather.

Check-List on Concrete Information

Prompt advice on concrete problems from these Universal Atlas Cement Co. offices:

New York—*Chrysler Building*
Pittsburgh—*Frick Building*
Birmingham—*Brown-Marx Bldg.*
Waco—*425 Austin Avenue*
Kansas City—*911 Walnut Street*
Minneapolis—*405 Second Ave., South*
Chicago—*208 South LaSalle Street*



. . . effective tricks that eliminate much worry from cold-weather concreting.

Good Advice

Next time you run into a snag on concrete, be it a winter-weather job or some other kind of a puzzler, give Universal Atlas a chance to help you wrestle with it. Write or phone the office nearest you (see check-list at left, above) and spill your troubles. You'll get good, sound, intelligent advice—and, naturally there will be no charge for it—it's a regular part of every barrel of Universal Atlas cement that goes to make good concrete.

(This page is an advertisement presented by the Universal Atlas Cement Co., *Subsidiary of United States Steel Corporation*)

ENGINEERING NEWS-RECORD

New York

February 15, 1934

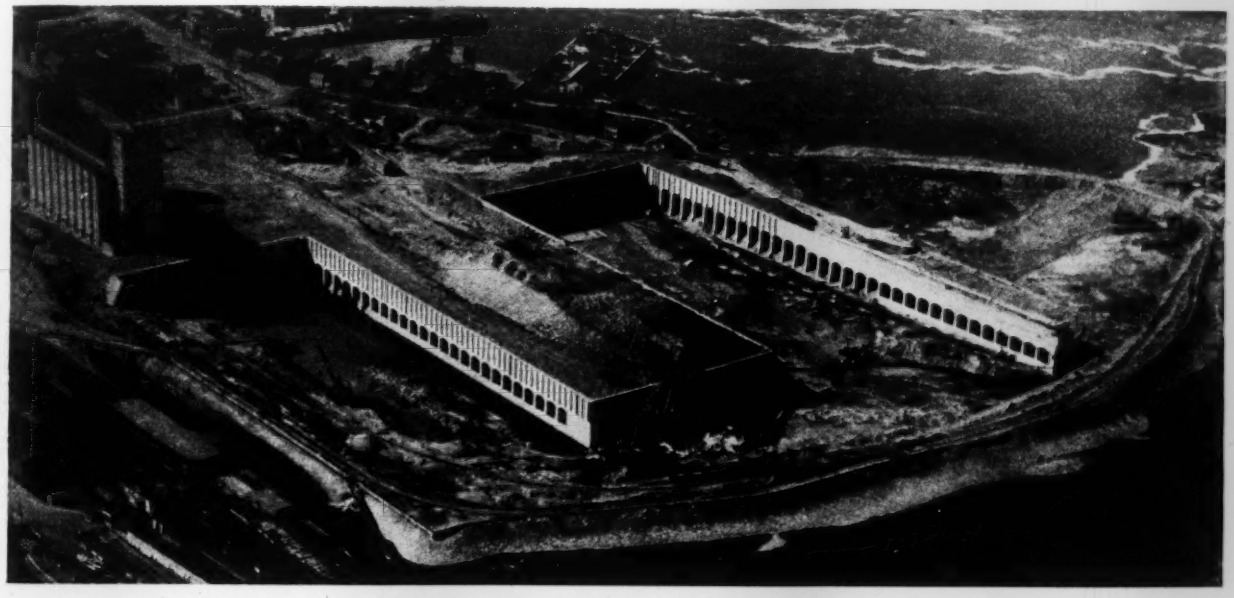


FIG. 1—WATERFRONT IMPROVEMENT at Saint John, N. B., includes this new pier and quay wall of unusual design. Steel-core cofferdam inclosing the work was built for tides of 28-ft. range.

Pier Construction in a 28-Ft. Tide

Long steel-core cofferdam inclosing 43 acres at Saint John, N. B., wrecked twice by high tides before work could proceed on piers of unusual design consisting of gravel fill retained between heavy gravity walls carried on concrete arches

SAINT JOHN, N. B., is one of the two leading winter ports on the Atlantic seaboard in Canada. In 1928 the Dominion government, through its Saint John Harbor Commission, started an expansion of port facilities on the west side of the harbor to include two sheds on a new pier, two new docking slips, a grain elevator and extensive railroad tracks and grain conveyors. The tidal range of 28 ft. at Saint John, which complicates any kind of marine construction, twice wrecked cofferdams protecting the new pier work. After the first failure the cofferdam was redesigned and rebuilt at a new location, and extended considerably to take in a new quay wall which would carry an additional pier shed. The new dam also failed under pressure of high tides, requiring some reconstruction and extensive stabilization measures, after which little further trouble was experienced.

Besides construction difficulties, the new work includes a pier design of unusual type. For the first time, on this continent at least, pier walls were built as gravity concrete sections carried on concrete arches, which in turn were supported on piers extending to rock.

When the new work was about half completed, a disastrous fire, in June, 1931, swept away practically all the existing piers and sheds on the west side of the harbor, sparing only a concrete grain elevator owned by the Canadian Pacific Railway. The old piers were of wooden crib construction, carrying wooden sheds. One of the buildings destroyed was a pier shed just nearing completion. This shed and several others have been replaced, though much of the destroyed area remains to be rebuilt. When the new pier and quay are completed and all the burned facilities are replaced, Saint John will have one of the finest ports on the Atlantic seaboard.

Important winter port

Lying on the western shore of the Bay of Fundy at the mouth of the Saint John River, Saint John, is an important winter port, serving, with the exception of Halifax, as the only accessible shipping point on the eastern seaboard of the Dominion when ice on the St. Lawrence blocks Quebec and Montreal to marine traffic. The city is the eastern terminus of the Canadian Pacific Railway and is also served by a branch of the Canadian National Railways. Millions of bushels of Canadian wheat are brought annually to the port for export. Several years ago the city's in-

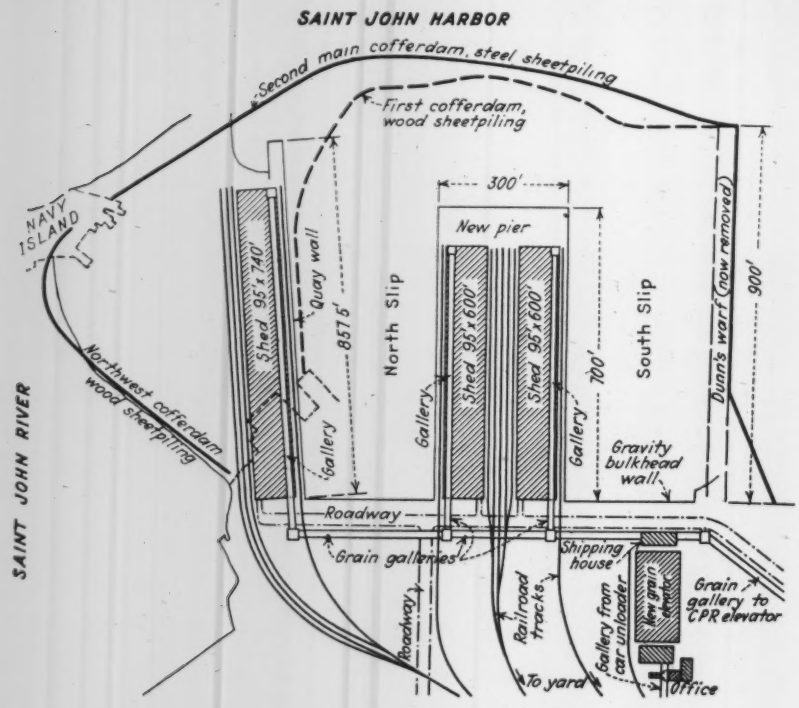


FIG. 2—PLAN of the new improvements at Saint John, showing location of cofferdams. Navy Island quay and shed were added to the project after failure of the first cofferdam made a more extensive inclosure desirable.

terests in port facilities were transferred to the Dominion government, which now controls the port and has charge of maintenance and new construction. The major facilities are located on the western side of the harbor and are served by direct connection with the Canadian Pacific. On the eastern side of the harbor are also several piers and one elevator, served by the Canadian National. Interconnections of the two railroads provide for complete rail service of the port.

Plans changed by dam failure

The original plans contemplated one new pier 300 ft. wide and 800 ft. long (to be built within a cofferdam), carrying two 95x700-ft. pier sheds, with provision made for extending the length of pier and sheds when desired. Docking slips dredged to a minimum depth of 35 ft. below low water were provided for on each side of the new pier. Contract for this work was let July 27, 1928. The contractor was to design the cofferdam, subject to the approval of the Harbor Commission.

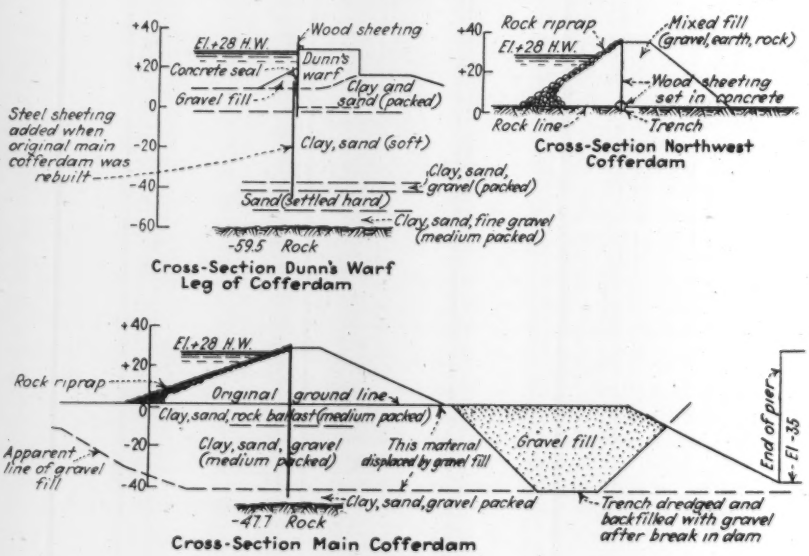
The location of the new pier was north of existing port developments in an area of old waterfront buildings, fishermen's docks and miscellaneous wreckage. Much of the area was flooded at high tide and exposed at low tide. Rock of a hard-shale type existed at various depths, from outcrops along parts of the shore to El. —60 (low water El. 0.0). Over the rock was a varying depth of soft river silt, gravel, hard and soft sand and clay formation.

Immediately to the south of the location of the proposed south slip was an old narrow wooden pier known as Dunn's Wharf, extending for 900 ft. into the harbor parallel to the proposed new pier. The contractor utilized this wharf as the southerly side of the cofferdam by driving wood sheeting along the south side (Fig. 3) for a distance of 600 ft. from the outboard end, and thence diagonally across Dunn's slip for a distance of 430 ft. to shore. From the outboard end of Dunn's Wharf a cofferdam was extended 900 ft. northward, clearing the proposed pier by 300 ft., and then turned west for 700 ft. to shore along the northerly side of the proposed north slip.

This cofferdam was a 6-in. tongue-and-groove wooden corewall backed by a rockfill on the outside and a gravel fill on the inside. It was built to El. 30, or 2 ft. above high-water line. A pile trestle was built on the inside of the corewall, from which the sheeting was driven and the fill material dumped. The trestle carried a standard-gage track. The corewall was driven a short way into a compacted formation. The fill material settled into the mud for a short distance, but never became stable. Prior to the construction of the cofferdam, the site of the south slip had been partially dredged to El. —30. Across this dredged area the cofferdam first showed signs of weakness, though steel sheeting had been used for the corewall at this point. Settlement of the fill gave warning of what was to come, and on Dec. 19, 1929, the dam failed completely.

After the failure the whole situation was reviewed, with Silas Woodard, consulting engineer of New York, acting as consultant for the contractors. Ultimate plans of the Harbor Commission included a quay wall, 300 ft. to the north of the pier, reclaiming the land by backfilling between Navy Island, a small island lying northeast of the north slip, and the quay wall, and by the erection of a pier shed upon the quay wall and filled ground. Though the commission had not intended to proceed with the

FIG. 3—FINAL DESIGNS of the three sections of the cofferdam. Following a break in the main dam, a gravel fill was placed to stabilize the inside toe, after which no further trouble was experienced.



Navy Island quay at this time, it was now recommended by the chief engineer of the Harbor Commission that the cofferdam should be redesigned and relocated to include the quay. This would enable it to be built at a considerable saving in cost over future submarine construction. The suggested reconstruction of the cofferdam considered a steel-core dam 1,600 ft. long from the end of Dunn's Wharf to Navy Island, located outside the original cofferdam, and a wood-core embankment from the island to the shore, 770 ft. long. The recommendation was accepted, and the Navy Island quay construction was made an extension to the original contract.

New cofferdam construction

Included in the plan for the new dam was the strengthening of the section along Dunn's Wharf. For a distance of 450 ft. from the outboard end of the wharf, steel sheeting was driven along the outside of the wood sheeting previously placed, the steel going deep below the bottom of the wood piling, well into a hardpan formation, with the top of the steel left just above original ground level. Between the wood and steel sheeting was placed a fill of gravel topped by a seal of tremmied concrete. This additional sheeting provided a remarkably tight wall, and no trouble or leakage was experienced with this section of the cofferdam.

The cofferdam section from the shore to Navy Island was built first. Since most of the site was exposed at low tide, a 6-in. wood corewall for this dam was set into a trench excavated in rock, which at this location was found close to the low-water level. After the sheeting was set up in the trench, it was concreted in place. An embankment of mixed rock and gravel fill was placed on each side of the wood corewall, with the outside bank protected by riprap paving. The embankment was placed from a trestle carrying standard-gage track, which was also used for rail access to the Navy Island end of the harbor-front section of the cofferdam.

The design of the main section of the cofferdam called for an embankment with a steel sheetpile corewall. Arched web 14-in. piling, weighing 40.8 lb. per ft. and up to 76 ft. long, was required. Fill material on the outside was gravel, paved with riprap, to provide additional watertightness. The inside embankment was of rock to give the dam stability. A standard-gage pile trestle driven along the inside of the corewall carried a wale against which the steel piling was driven. Driving of the track trestle and steel-core was carried on simultaneously, proceeding from the Dunn's Wharf end of the dam. Steam crawler draglines acting as cranes handled the pile hammer, operating on mats placed across the trestle stringers. Placing of the fill followed close behind the driving.

Gravel for the outside fill was dredged

FIG. 4—LACK of lateral support on the inside toe caused this break in the main section of the second cofferdam.

FIG. 5—PULLING the steel sheetpiles of the main cofferdam proved difficult, requiring the use of A-frame extractor supports with large draglines furnishing the pulling power.

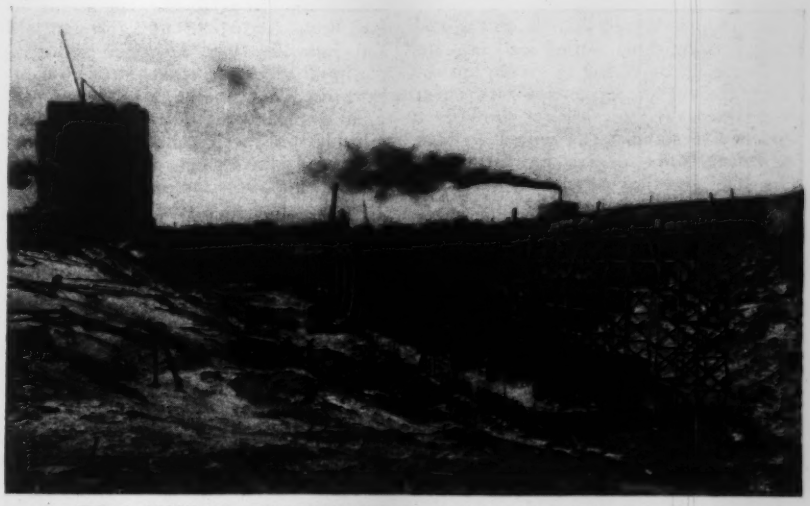
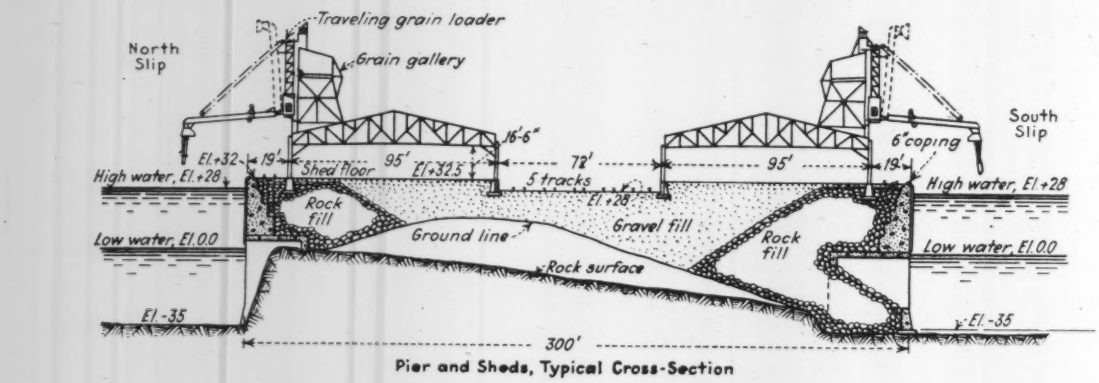
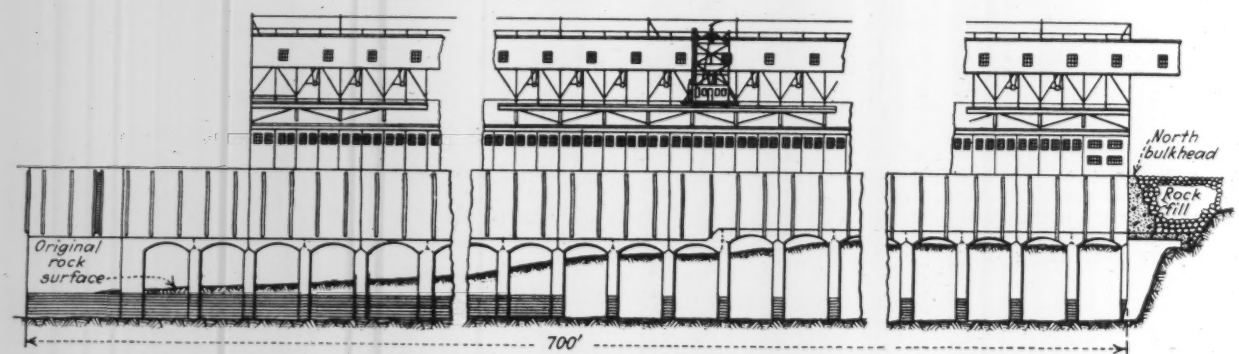


FIG. 6—MOST OF THE CONCRETE was wheeled to place in buggies over light trestles, as shown here, and dumped into final position through flexible spouts. Live steam was used to protect the fresh concrete during cold weather.



Pier and Sheds, Typical Cross-Section



Pier and Sheds, Elevation North Wall

FIG. 7—THE GRAVEL AND ROCK fill supporting the pier sheds is retained by concrete walls carried on arches and buttresses. The clear-span sheds carry grain galleries and ship loaders.

from Courtenay Bay across the harbor, loaded into hopper scows and dumped as close to final position as possible. Draglines operating from the trestle rehandled the gravel as necessary to build up the fill to El. 30, either by recasting or by loading into dump cars for movement to final location. Rockfill for the inside embankment was excavated from the site near shore and was hauled out to place in dump cars. Very little rehandling of rock was necessary. A locomotive crane with a clamshell assisted in final placement of the fill material.

Soundings showed that the gravel and stone embankments settled well into the soft material overlying the rock, but the exact amount of settlement was never determined. The banks showed a tendency to slump away with low tides, indicating some degree of instability. The steel sheeting penetrated deep into the harder strata, being driven far below the depth reached by the wood corewall on the original dam.

Because of the high tidal range a great saving in pumping could be effected by closing the dam at extreme low water, but this required quick and effective work. A successful plan of closure was devised by providing two timber sluiceways through the dam, a gap of eight sections of piling being left in the corewall at each sluiceway. To close these breaches eight sections of piling were clamped and bolted together to form a gate, and at low water these gates were dropped into the openings by cranes, the bolts and clamps being quickly removed and the piling driven down singly.

Cofferdam again fails

The long dam appeared to be satisfactory, and unwatering was begun. But once again the pressure of high tides overcame the resistance of the barrier where the dredging for the south slip had been carried through the dam site. On June 28, 1930, a section about 200 ft. long suddenly broke loose and slid inward. This time E. G. Cameron, principal assistant engineer of the Welland Ship Canal, was called in as a consultant. His report of the cause of failure and recommendations as to a future course of action are summed up as follows:

The cofferdam failed because unwatering removed a necessary support. Rock in the backing embankment pushed down and away from the sheeting, and cracks opened up in the softer underlying material. Heavy rains aggravated the settlement and lubricated the sliding material. As the supporting rock moved away from the sheeting, the corewall was unable to withstand the high head of the tides, resulting in rupture of the steel core. The sheeting parted at two points, resulting in a section 80 ft. long being bent inward to a nearly horizontal position about 20 ft. below water level. A 200-ft. section of the dam to the north of the break moved inward in a long sweep. The top of the sheeting settled down to a maximum of about 20 ft., and the lower ends were pulled out of the hard bottom, resulting in a vertical section of sheeting resembling an elongated letter S.

Recommendations for stabilization of the dam called for careful repair of the breach and the dredging of a trench to hard material along the inside toe of the rockfill, and backfilling of this trench with gravel to provide lateral support for the soft material underlying the rock backing. After the expense of rebuilding the original cofferdam, the contractor was in no position to undertake the extensive stabilization measures proposed. The Harbor Commission now offered to take over the entire cofferdam, and the contractor agreed to proceed with the work as recommended, repair the break and remove the dam after completion, all at cost price without profit or overhead allowed.

The first step was to remove enough of the wrecked sheeting to admit a dredge to the inside of the dam for the purpose of excavating the trench. Divers of the Merritt-Chapman & Scott Corp., equipped with underwater cutting torches, burned out a channel through the twisted mass of steel piles. A trench with a bottom width of 30 ft. was then dredged and backfilled with gravel as planned.

The break was repaired by driving a

290-ft. loop of 76-ft. sheetpiles around the outside of the breach. Some of the piles were spliced to 90 ft. to gain desired penetration. As an added precaution against further trouble, the entire length of corewall was driven down from 2 to 4 ft., splices being added where the individual piles went below high-water level.

Prior to completion of closure of the break, the sluiceways were opened up, and final closure was accomplished in the same manner as before by use of gates of eight sections of sheeting bolted together. Pumping out was accomplished by two 12-in. and two 8-in. centrifugal electric-drive pumps mounted on a raft. As the unwatering neared completion, one pump of each size was discontinued to slow up the rate of lowering of the pool level. This gave the banks time to drain out without inviting further slumping. Unwatering during the construction period was done by pumps placed in a sheeted sump located in the gravel stabilizing fill, holes burned in the sheeting providing waterways. Several small pumps were used to dry up local pools within the inclosure.

Removal of cofferdam

About 200,000 cu.yd. of backfill material were needed for the section behind Navy Island quay and in the main pier, and the plan for cofferdam removal contemplated salvaging most of the embankment material and the gravel in the inside toe trench for this purpose. Preliminary to flooding, the inner gravel fill was removed and salvaged, the material under the rockfill having consolidated sufficiently to carry the embankment without the toe support.

By Oct. 15, 1932, work had progressed to the point where removal of the dam was possible. Pumps were shut down for eleven days to allow water to rise within the inclosure before wrecking the dam. But the barrier was so tight that leakage in this period made a pool less than 5 ft. deep. On Oct. 26, three 1x2-ft. holes were cut in the sheeting at El. 15 at one of the sluiceways, permitting water to enter the dam at high tide. To prevent wash, the water was carried over the inner embankment in a wooden flume. By Nov. 2 the inclosure had filled to the level of the openings and the sheeting was pulled in the two sluiceways, thus creating two 8-ft. channels.

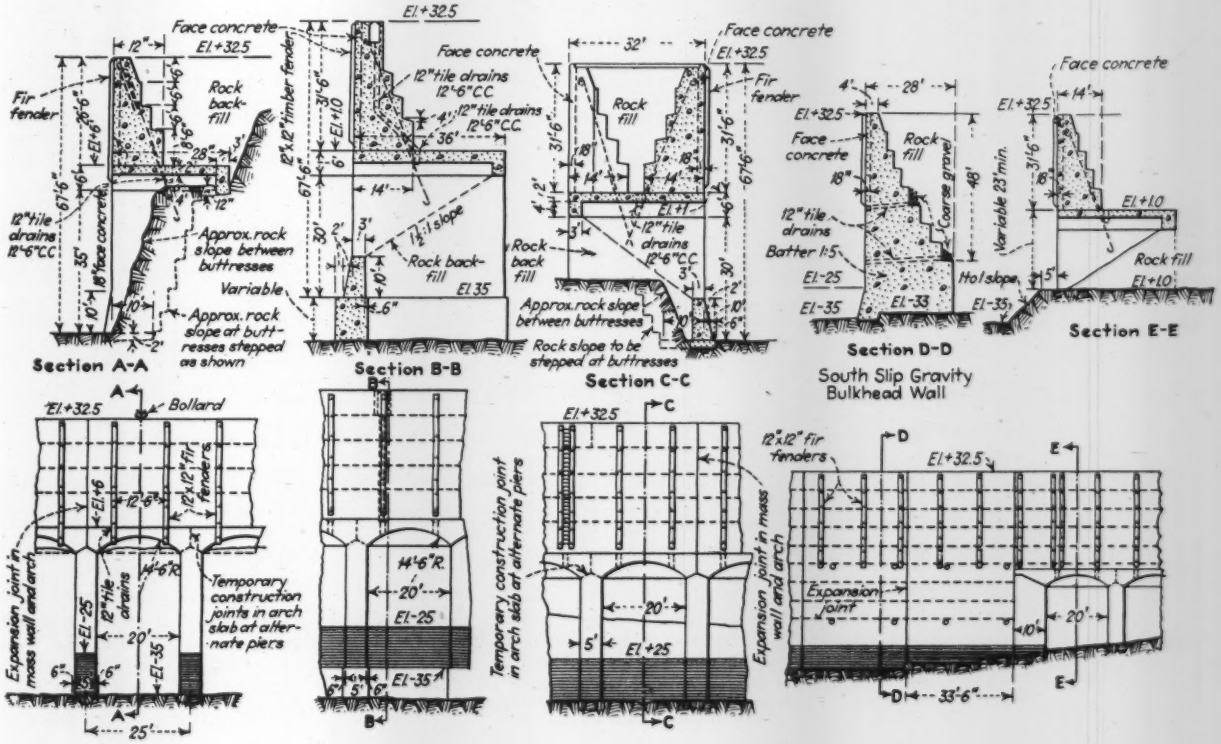
Land plant was recommended for wrecking the dam because of the need of a stable foundation necessary for the operation of the pile pullers. The plan was to use draglines both for pulling piles and for salvaging embankment material, two machines starting at the repaired break section and working away from each other. Later a third machine was added.

Removal of the wrecked sheeting at the point of failure proved difficult. Finally a dredge was brought in to dig down alongside the damaged sheeting, which was successfully removed in segments by scows carrying A-frames rigged with extractors. Once past the repaired section, it was expected that the removal of the dam could progress rapidly.

On November 8, 1932, two draglines started work. These were both steam rigs of large size, equipped with 80- and 100-ft. booms. Enough excavation was done to expose the top of the sheetpiles. The first method tried in pulling the sheets was a direct lift from a high boom. The rigs were capable of exerting lifts of 25 to 30 tons, in addition to the force exerted by pile extractors. One rig carried a regular heavy-duty pile extractor; the other an inverted steam pile hammer operating in a sling of 500 ft. of cable wrapped around the hammer. Despite the tremendous lift exerted with this set-up, the piles refused to move. An effort was made to loosen the sheets by driving them down from 6 to 24 in.; then jetting was tried, and finally dynamite was exploded in well-drill holes, all without success.

After the scheme of using the crane booms directly on the piles had proved unsatisfactory, a 30-ft. heavy-timber A-frame was added to each pile-pulling rig, the extractor being handled by a 7-part line supported by the frame, with the fall line going back to the drag drum of the crane. These A-frames worked from timber cribbing placed on the embankment. Ample pulling power was available with these set-ups, but trouble was encountered at once with the ex-

FIG. 8—DETAILS of various sections of the pier, quay and bulkhead walls designed for different foundation conditions. All lower drawings are waterfront elevations.



tractor connections. After being heavily reinforced, the connections on the regular extractor gave no further trouble, but the cable slings on the inverted hammer repeatedly failed. Furthermore, the stretch of cables dampened the effectiveness of the hammer blow. A new harness was tried, with side straps of 1½x20-in. plate, coupled with heavy pins to yokes and a steel billet anvil, but the side straps of mild steel failed within 24 hours. The harness was again rebuilt, using a heavier anvil and larger side straps of chrome-vanadium steel and pins of chrome-nickel steel. This heavy harness worked well, although occasionally a part failed. The weight of the hammer and harness was 4½ tons, and the A-frame, blocks and cables weighed an additional 8½ tons, making a 13-ton unit to be handled every time another pile was attacked. The last of the cofferdam was removed on May 12, 1933, after six months of difficult work. Dunn's Wharf was torn out with the remainder of the dam.

Pier walls of new design

The walls of the main pier, Navy Island quay and the bulkheads at the shore ends of the two slips are of a new and unusual design. In general, the design is as follows: the top 31½ ft. of the wall is a concrete gravity section with a vertical face and stepped back, 14 ft. thick at the base. This gravity wall rests on multiple concrete arches, the arches having a crown thickness of 2 ft. and a clear span of 20 ft. with a 14½-ft. radius at the soffit. The arches are supported by piers or buttresses 5 ft. wide, 25 ft. c. to c., extending downward at least to El. —35 where rock exists at or above that elevation, and deeper if necessary to reach solid ledge. The slabs are 36 ft. wide, extending back from the face of the wall a distance of 22 ft. beyond the back side of the gravity section base.

The design was based on the use of a rockfill backing with a gravel fill placed behind the rock. The elevation of ledge rock varied considerably over the site. Where ledge existed at or above the level at the arches at their back or inside edge, a cutoff wall was built across the arch openings, confining the rockfill behind and above the slabs. But in locations where the top of the ledge was below this level, the rock backfill was permitted to run between the piers and to come to rest on a 1½-to-1 slope below the slabs. A toewall built between the piers at their outside ends keeps the rockfill from extending into the ship area.

Because of the heavy surcharge imposed by the new grain elevator located near by, the south half of the south slip bulkhead was designed as a gravity-section wall. This was built in advance of general excavation, being constructed in a sheeted trench reaching a maximum depth of 55 ft. below water level.

The customary European practice was followed in specifying concrete mixtures for the walls, a richer mix being stipulated for the outside 18 in. of the gravity-section wall. Specifications called for 658 lb. of cement per cubic yard of concrete in this richer face section and 564 lb. per cubic yard for all remaining concrete. For the protection of the face of the wall, vertical 12x12-in. fir fenders were fastened to the concrete, spaced 12½ ft. c. to c.

Excavation and filling

Exclusive of the cofferdam, the work involved approximately 1,500,000 cu.yd. of dredging, 1,000,000 cu.yd. of earth excavation and 470,000 cu.yd. of rock removal. All of the rock and earth was used in backfilling the pier, behind the quay and in building up adjacent ground for railroad yards.

As was to be expected, heavy equipment was brought into play for this huge task of excavation. Heavy-duty draglines predominated in excavating equipment. These rigs were steam-operated, traveling on crawlers, except one of the largest which moved on skids and rollers. Well drills pierced the rock ledges to be blasted away. All excavated material was handled by standard-gage railroad equipment. Tracks were shifted around the site as required, entering the area of excavation from the cofferdam and shore line on earth and rock ramps. Draglines also spread fill material into place as dumped from cars.

Every yard of concrete was wheeled into place in buggies. Small mixers were spotted around the work at points accessile to rail delivery of cement and aggregate. Light trestles were built ahead and above the wall sections. Concrete was hoisted in towers from the mixers to trestle level. Final disposition to low sections of concrete work was by means of flexible metal spouts. Concreting continued without delay in cold weather. Fresh pours were protected by live steam released under tarpaulin canopies. Aggregates were heated also.

Other work of interest

Three pier sheds, a grain elevator, grain conveyors and 10 miles of railroad track are included in the new development. Two of the sheds, 95x600 ft., are located on the pier; the third, 95x740 ft., is situated on the Navy Island quay. On the pier the sheds are served by five railroad tracks located between the buildings and depressed to bring the car floor level with the pier deck. A single track also runs down the walls of the pier at deck level. The Navy Island shed is served by one track on the water side and three low-level tracks on the opposite side. The sheds are built of structural steel, the sides being covered with sheet metal. The roofs are 3-in. wood mill-type with built-up asphalt and gravel covers. Both sides of the sheds are equipped with continuous lines of horizontal sliding shipping doors extending the full length of the sheds. Roof spans are clear, eliminating obstructing columns within the sheds, the trusses clearing the floor by 16½ ft. The entire shed structures rest on backfilled areas. East building is floored with a 6-in. concrete slab. Surmounting each of the three sheds on the waterfront side is a steel framework carrying grain conveyors and a traveling grain loader. These loaders can be spotted in any position, loading directly into the ship holds.

The new elevator consists of 36 concrete bins of 24 ft. 5-in. inside diameter. These bins have a capacity of 1,368,000 bu. An additional 208,000 bu. can be stored in 24 interspaced bins, making a total capacity of 1,576,000 bu. Wood piles carry the elevator structure. Elevated grain conveyors completely serve the entire port area on this side of the harbor. Grain will be unloaded from box cars by a car dumper and then transferred to either the new or old elevator or direct to ships at any of the rebuilt or new piers.

Engineers and contractors

All engineering, supervision of construction and management of the port is under the Saint John Harbor Commission, a Dominion government body. The new project was designed by Alex Gray, chief engineer and general manager of the commission, and was carried out under his direct supervision. Sir Alexander Gibbs and partners were consulted on the design of the pier walls. Victor Chesnut was principal senior engineer in charge of design and construction. D. C. Ross is resident engineer. The Atlas Construction Co., of Montreal, was awarded contracts for the new pier, dredging of the two slips and the Navy Island quay. J. C. Morgan is superintendent for Atlas. Brodrick Contractors, St. Catherines, Ontario, were subcontractors on excavation, with W. B. Brodrick in charge. The elevator was designed by John S. Metcalf Co., Ltd., Montreal, and was built by E. J. M. Cape & Co., Montreal. The Saint John Dry Dock & Shipbuilding Co. is erecting the pier sheds and conveyors. J. B. Sterling is superintendent in charge for both the two last-named firms. All track work is being installed by the Canadian Pacific Railway.

New Moffat Tunnel Service

The Moffat Tunnel will be used for full passenger service from Chicago to the Pacific Coast by the Chicago, Burlington and Quincy R.R., after June 1, according to an announcement made recently by Ralph Budd, president. It is expected that by that time the Dotsero cutoff, connecting the Moffat line west of the tunnel with the Denver and Rio Grande Western R.R., will have been placed in service.

Research Notes
—Current Work at Lehigh University

THE FRITZ Engineering Laboratory of Lehigh University, Bethlehem, Pa., was probably the most prominent and the best-equipped structural engineering laboratory in the country at the time of its construction in 1909. Although many changes have taken place during its 25 years of existence, it still stands as the most prominent structural laboratory among Eastern colleges.

Concrete Columns—Current research work includes the continuation and completion of some notable studies begun under the late Prof. W. A. Slater, whose appointment as director of the laboratory in 1928 marked the establishment of a permanent research organization. Most important of these studies is the reinforced-concrete column investigation under the sponsorship of the American Concrete Institute, partly at Illinois and partly at Lehigh. Although the major part of this investigation has been completed and the results reported, a number of columns are still under sustained loads and strain observations are recorded at regular intervals. (Lehigh University Research Circulars No. 64 and 81 contain the first four progress reports.)

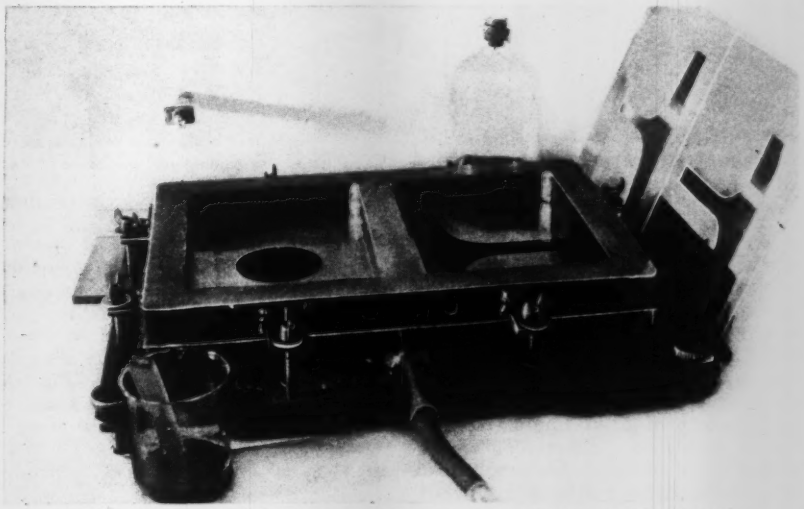
Reinforced Brickwork—The reinforced-brick column investigation, reported in *Engineering News-Record*, Jan. 4, 1934, was the first rational investigation into the structural qualities of this construction method, and furnished data for a scientific basis on which to design reinforced-brick columns for load-carrying capacity. Further studies in this field will be carried out as soon as conditions permit.

Aggregates and Cements—Plain concrete has been studied for several of its most important features, among which the durability experiments on concrete containing ten kinds of aggregate, thirteen brands of standard portland cement and five types of high-strength cements are the most prominent. The results of the first part of these studies—that is, of the concrete-making qualities of the different aggregates—are reported in a paper "Durability of Concretes and Aggregates," in the Nov.-Dec. (1933) number of the *Journal* of the American Concrete Institute. This investigation showed that the ingredients in the concrete should be judged by their quality-giving properties in concrete and not by results of tests upon the individual ingredients alone. It also showed that a high durability of concrete may be obtained with various types of ingredients, provided that the proper concentration of cement in the paste and the proper curing of the concrete are used.

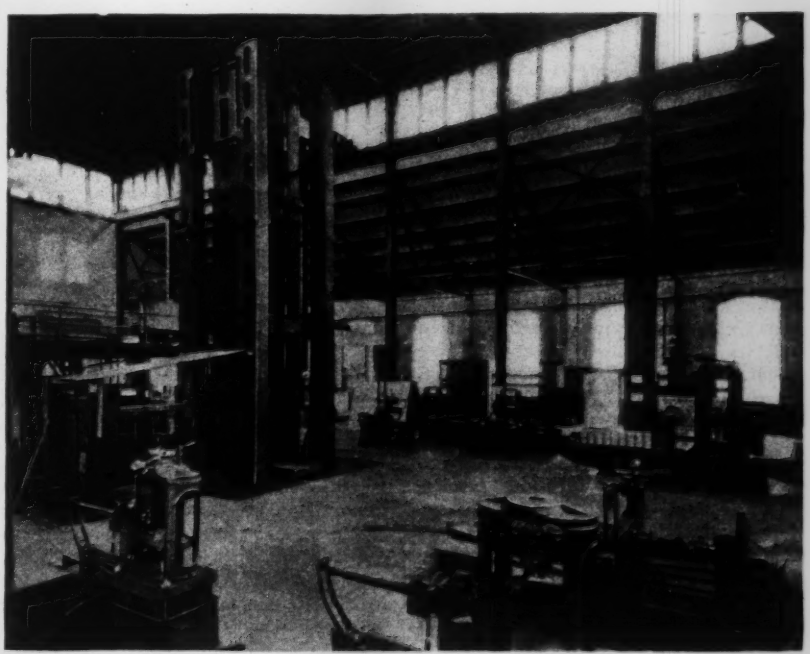
The investigation of the durability quality of the eighteen different cements will continue for at least another year. The durability of the concrete is measured by the loss in weight resulting from repeated freezings and thawings.

Clay Admixture—The question of the effect of very fine materials, such as clay, upon the various qualities of concrete, such as placeability of the mix, compressive strength, permeability and durability of concrete, was recently given an extensive study. The results gave a very impressive indication of the value of very fine materials in concrete. The report is now completed and ready for publication.

Girder Web-Buckling—In coopera-



TORSIONAL RESISTANCE of irregular cross-sections is determined with this apparatus by means of the soap-film analogy.



FRITZ ENGINEERING LABORATORY, showing the 800,000-lb. Riehle, the 300,000-lb. Olsen and several of the 50,000-lb. universal screw-power testing machines.

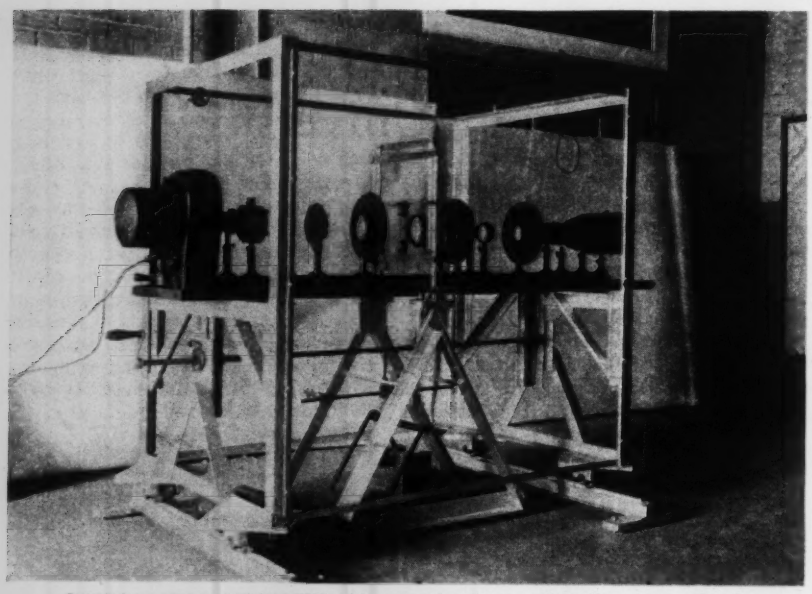


PHOTO-ELASTIC APPARATUS with supporting frame and loading rig, purchased with a bequest from the late Mansfield Merriman.

tion with the Bethlehem Steel Co. and its fabricating division the McClintic-Marshall Corp., an extensive investigation into the web-buckling of steel beams and girders was carried out recently. The results, which will be published in the February *Proceedings* of the American Society of Civil Engineers, gave for the first time a rather complete experimental solution of this problem. A supplement to this web-buckling investigation was a study of the shearing properties and Poisson's ratio of structural and alloy steels. The report of this study appears in the 1933 *Proceedings* of the American Society for Testing Materials. The outstanding result was the low yield-point stress in shear of structural steel, being in many cases only about 50 per cent of the yield-point stress in tension. The Poisson's ratio was found to be nearly 0.3, regardless of type of steel.

Torsion of Steel Shapes—Probably the most unknown problem of structural-steel design is the one on torsional resistance. At the suggestion of and with the support of the McClintic-Marshall Corp., a thorough investigation was started in the fall of 1932. This investigation has included a great number of torsion tests of full-sized structural-steel beams, supplemented with a successful application of the soap-film analogy for tests on effect of slope of flanges and thickness of fillets. The forthcoming report will for the first time give a complete experimentally verified solution of the torsional problem in structural-steel sections.

Seat Angles—Another investigation in the field of steel was recently started on the problem of the load-carrying capacity of seat angles. This investigation is carried out in cooperation with the Structural Welding Committee of the American Bureau of Welding, with support from the Bethlehem Steel Co. An excellent assistance in the solution of this problem is found in the Winkler-Zeiss photo-elastic apparatus recently acquired by the laboratory with funds bequeathed by the late Prof. Mansfield Merriman, one-time head of the department of civil engineering, Lehigh University. It is planned to make much use of this apparatus in the solution of problems particularly difficult for theoretical analysis of stress distribution.

The laboratory is under the administration of the department of civil engineering, of which Prof. Hale Sutherland is the head. The writer is in charge of the laboratory, with C. C. Keyser as assistant. At present, three research fellows are carrying out work on torsional resistance of structural-steel sections, seat angles in structural design, photo-elastic studies of seat angles, and other engineering problems.

INGE LYSE,
Research Associate Professor of Engineering Materials, Lehigh University.

Well Water Causes Sewer Stoppages

By M'Kean Maffitt
Superintendent Water & Sewers Wilmington, N. C.

AN UNUSUAL CAUSE for sewer stoppage was noted some time ago by the city of Wilmington water and sewer department. The sewer connection to an office building having basement fixtures and supplied from a deep well on the premises began to give trouble shortly after a commercial chemist using large amounts of water in his operations rented the top floor. There had been no trouble with the sewer for a number of years previous to that time, but about eighteen months after the chemist moved in, there was a stoppage in the sewer lateral, which was easily removed by a cable run into the manhole. Within a month, however, stoppage recurred, and although each time it was easily removed, it occurred with increasing frequency until, finally, ten hours of office operation was sufficient to block up the lateral. By this time the backing up of water and sewage caused so much inconvenience that the basement tenants moved out.

In a final attempt to determine the cause of the stoppage and before digging into the line attempts were made to force a sewer scoop through the line in the hope that it would break the obstruction and thus eliminate the cost of digging; the scoop would not pass through the line but ran afoul some object that felt like a raised cement joint. After several unsuccessful attempts to scoop the line, a final effort was made which put the scoop farther in the line than before but failed to pass it through. However, upon pulling back the scoop we found that it contained large pieces of a substance that appeared to be solidified coal ash or clinker, which seemed to be the entire cause of the stoppage, since there was another one within a period of five hours.

Analysis of the solid matter showed that it was composed of 80 to 90 per cent calcium carbonate, the rest being fine sand and other matter that would be expected from a deep well. Analysis of the water from the well on the premises showed free carbon dioxide content of 267 p.p.m., and calcium 196 p.p.m. Evidently the loss of carbon dioxide upon the discharge of the water into the fixtures and sewer line caused the deposition of calcium carbonate in sufficient quantities to have accumulated into an obstruction sufficient to cause stoppage, and thus it was apparent that only by chemical action could the obstruction be removed. Accordingly, when the building was unoccupied, 6 qt. of muriatic acid were run into the sewer and thoroughly stirred by the use of wooden sewer rods. After allowing the acid to react for 30 min., the sewer was washed with fresh water. After six months of operation since the application of the acid treatment, this latter has given no further trouble, so it is assumed that there will be none until the calcium carbonate again deposits in sufficient quantities.

Sewerage System Utilized for Disposal of Garbage

Facilities at Baltimore permit discharging from 50 to 100 tons of ground garbage daily into the outfall sewer during a short period in summer, with ultimate disposal at the sewage works

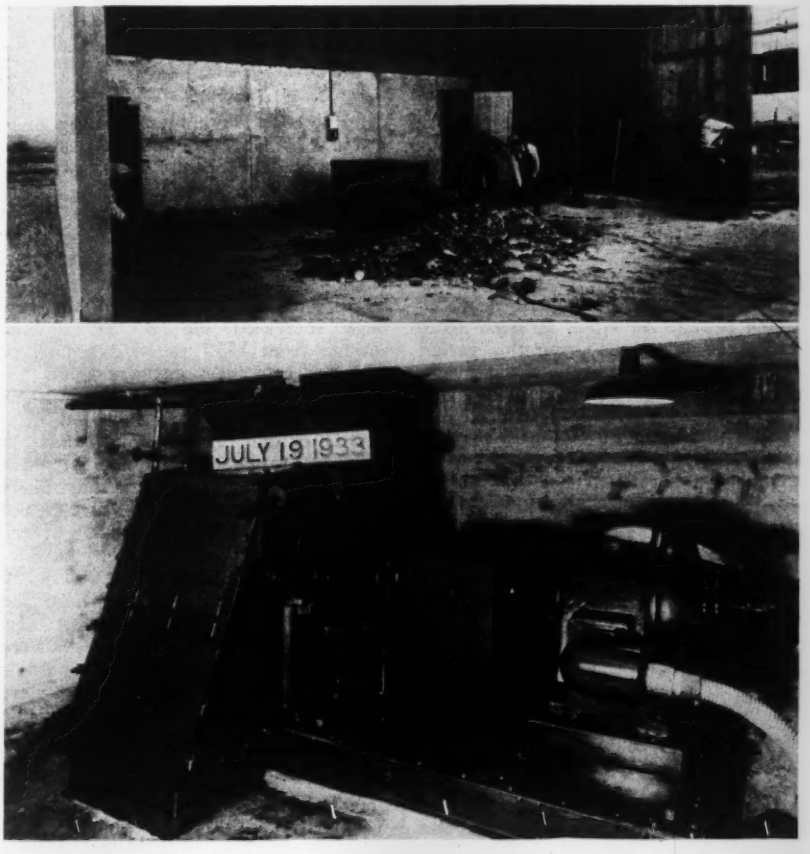
By C. E. Keefer
Principal Assistant Engineer, Bureau of Sewers, Baltimore, Md.

DURING the summer of 1933, equipment was installed in Baltimore for grinding a portion of the garbage during periods of peak production, discharging the pulp into the outfall sewer and treating the material along with the sewage at the sewage works. The grinding station, which was erected at a cost of $8,585, was operated for 24 days, during which time 1,693 tons of garbage were disposed of. It is believed that the peak production of garbage can be handled much cheaper this way during a short period in summer than by building additional incinerator capacity that would be used infrequently. Furthermore, so far as could be judged, no detrimental effect on the operation of the sewage works was observed.

In addition to serving the practical purpose of disposing of a certain quantity of garbage, the grinding station offered a means of checking on a large scale certain laboratory experiments on garbage disposal made at the Baltimore sewage works. These investigations consisted of digesting ground garbage with sewage sludge in the laboratory at about 27 deg. C. The results (see *Sewage Works Journal*, January, 1934) indicated that garbage can readily be digested with sewage sludge within 30 to 40 days with the production of 600 to 700 cc. of total gas and from 300 to 400 cc. of methane per gram of dry volatile solids in the garbage.

The garbage grinding station, as shown in Figs. 1 and 2, was constructed by day-labor forces in the eastern section of the city about 60 ft. from the outfall sewer. The station consists of a wooden shed set immediately above a concrete pit containing the grinder. The superstructure is 24x26 ft. in plan with three sides closed and the fourth side open. The floor and the area immediately in front, where the garbage is dumped, are of concrete. An opening 2x3 ft. 9 in. is provided in this floor, through which the garbage falls. A sheet-metal hopper connects this opening with the top of the grinder, which is immediately below. Around three sides of the hopper there is a 1½-in. perforated pipe for adding water to the garbage in order to flush the material through the machine.

FIG. 1—GARBAGE STATION at Baltimore, Md., and grinding machine. Trucks dump the garbage on a sloping concrete floor, and it is pushed into a hopper (top view) leading to the grinding machine shown in the lower view.



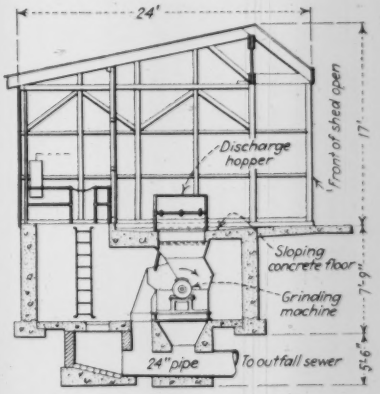


FIG. 2—CROSS-SECTION through garbage grinding station.

The grinder has a rated capacity of 20 tons an hour, and is operated by a 100-hp., 1,140-r.p.m., slip-ring motor. The grinder consists of a cast-iron housing, which is open at the top and the bottom, and is lined with renewable chilled iron liners. Passing horizontally through the center of the machine is a 5½-in., steel drive shaft, from which thirty-nine 1¼x3¼x10¼-in., high-carbon, steel hammers swing. Set in the bottom of the grinder is a bar grating, consisting of several rows of parallel, sharp-edged steel bars, which are in a horizontal position and are equidistant from the drive shaft. The clear spacings between the bars vary from ¾ to 1½ in. The distance between the outer ends of the hammers and the bars is ¼ in. The material to be pulverized enters the top of the machine, is ground to pieces by the rotating hammers and falls through the bar grating. The pit, in which the grinder sets, is 15x17 ft. in plan and 6 ft. 10 in. deep.

The ground garbage drops into a 24-in. vitrified pipe, laid on a 4.6 per cent

grade, and discharges into the outfall sewer. This sewer, which has a horseshoe cross-section, is 12 ft. 3 in. wide and 11 ft. high with a fall of 0.25 ft. per 1,000 ft. The distance along the outfall sewer from the grinding station to the sewage works is about 2.1 miles. During the period that the garbage was ground the average sewage flow was about 83 m.g.d. with maximum flows of about 120 m.g.d and minimum flows of about 48 m.g.d. The minimum, average and maximum velocities in the sewer were calculated to be 2.7, 3.2 and 3.5 ft. per second, respectively.

The station was in service from Aug. 12 to Sept. 27, 1933, during which time about 70 tons of garbage were ground daily. The maximum quantity of material disposed of during any one day was 107.6 tons. All of the garbage was accurately weighed before it was ground. A total of 7,370 kw.-hr. of electric current was used, which cost $287.44 at 3.9c. per kw.-hr. The power required to grind 1 ton of garbage was 4.35 kw.-hr. From four to six men were required to feed the garbage to the grinder. Next summer it is planned to perform this operation by means of a bulldozer so that the number of men can be reduced.

No trouble was encountered in the operation of the station. The only material that offered any difficulty in grinding was corn husks. These had to be fed at a slower rate into the machine than other kinds of garbage in order not to stall the motor. The bar grate in the bottom of the pulverizer also had to be cleaned more frequently when grinding corn husks. It was found necessary to introduce a stream of water from a 6-in. water main into the sewer beneath the grinder in order to flush the pulverized material to the outfall sewer.

TABLE I — CHEMICAL ANALYSES OF RAW SEWAGE, AUG. 18, 1933
(58.5 tons of ground garbage added to sewage between 10.50 a.m. and 5.30 p.m.)

Time	Sewage Flow, M.G.D.	Solids — Total P.P.M.	Solids — Dissolved P.P.M.	Solids — Suspended P.P.M.	Solids — Settling P.P.M.	B.O.D. 5 Days at 20° C. P.P.M.	pH
8 a.m.	62	1,798	1,215	583	386	204	6.5
9 a.m.	69	748	462	286	224	234	6.5
10 a.m.	62	582	487	95	70	144	6.7
11 a.m.	69	686	594	92	63	118	6.7
12 m.	76	736	634	102	63	195	6.8
1 p.m.	70	828	598	230	163	243	6.8
2 p.m.	96	1,196	655	541	443	375	6.8
3 p.m.	95	808	470	338	264	360	6.8
4 p.m.	93	888	547	341	286	480	6.7
5 p.m.	93	790	526	264	197	367	6.5
6 p.m.	94	822	505	317	243	395	6.3
7 p.m.	91	728	501	227	173	322	6.3
8 p.m.	91	786	550	236	172	340	6.3
9 p.m.	93	702	501	201	160	312	6.3
10 p.m.	92	758	544	214	169	280	6.3
Average	..	857	585	271	205	291	6.6

TABLE II — CHEMICAL ANALYSES OF RAW SEWAGE, AUG. 31 AND SEPT. 1, 1933
(28.2 tons of ground garbage added to sewage between 10.30 a.m. and 12.30 p.m.)

Time	Sewage Flow, M.G.D.	Solids — Total P.P.M.	Solids — Dissolved P.P.M.	Solids — Suspended P.P.M.	Solids — Settling P.P.M.	B.O.D. 5 Days at 20° C., P.P.M.	pH
Aug. 31, 1933							
8 a.m.	59.0	850	786	64	44	150	6.9
9 a.m.	69.0	926	875	51	40	86	6.8
10 a.m.	70.5	990	916	74	55	76	6.8
11 a.m.	87.0	912	825	87	63	118	6.8
12 m.	93.5	714	580	134	99	190	6.8
1 p.m.	94.5	768	509	259	201	334	6.6
2 p.m.	96.0	696	478	218	164	305	6.8
3 p.m.	97.0	678	458	220	167	307	6.8
4 p.m.	98.5	732	513	219	161	307	6.3
5 p.m.	100.0	740	495	245	191	330	6.6
6 p.m.	100.5	712	478	234	183	335	6.3
7 p.m.	98.5	814	572	242	185	345	6.3
8 p.m.	97.5	822	611	211	158	262	6.3
9 p.m.	94.5	728	525	203	156	297	6.3
10 p.m.	86.0	784	589	195	149	322	6.3
11 p.m.	77.0	692	543	149	107	277	6.3
12 p.m.	73.0	744	576	168	131	295	6.3
Sept., 1, 1933							
1 a.m.	70.0	682	513	169	126	282	6.3
2 a.m.	66.5	604	414	190	150	265	6.5
3 a.m.	64.0	546	415	131	94	195	6.5
4 a.m.	63.5	412	304	108	86	185	6.7
5 a.m.	64.0	480	401	79	59	165	6.7
6 a.m.	49.0	442	365	77	59	123	6.9
7 a.m.	49.5	428	355	73	61	133	6.9
Average	....	703	545	158	120	236	6.3

Effect on sewage treatment

The effect of the garbage on the sewage and the operation of the sewage-treatment plant were carefully observed. As judged by the eye, no increase in the strength of the sewage could be detected on those days when the garbage was ground. Of course, when the sewage was analyzed an increase in strength was observed.

Two groups of tests of the sewage were made while the garbage was being ground. The first was on Aug. 8, when 58.47 tons of material were disposed of. The grinding began at 10.50 a.m. and was continued quite uniformly until 5.30 p.m. It is estimated that it took from 1 to 1½ hours for the garbage to reach the sewage works. The result of the analyses of the sewage, which was collected once an hour from 8 a.m. to 10 p.m., are given in Table I. The suspended solids averaged 271 p.p.m., and the settling solids 205 p.p.m. The suspended solids and the settling solids in the raw sewage at Baltimore for the past five years in August have averaged 234 and 167 p.p.m., respectively. The 5-day B.O.D. of the raw sewage, as indicated by Table I, was 291 p.p.m.; the 5-day B.O.D. of the raw sewage has averaged 289 p.p.m. for the years 1928-'32. A second group of analyses was made over a 24-hour period on Aug. 31 and Sept. 1, as indicated by Table II, when 28.2 tons of garbage were added to the sewage on Aug. 31 from 10.20 a.m. to 12.30 p.m. During this period the suspended solids in the sewage were 158 p.p.m., the settling solids 120 p.p.m., and the 5-day B.O.D. was 236 p.p.m.

As it is always difficult to collect representative samples of raw sewage, there might be some question as to whether the results given in Tables I and II indicate the true character of the sewage. It was decided, therefore, to make an additional series of tests for the special purpose of determining to what extent ground garbage increased the B.O.D. of raw sewage. Fifteen samples of raw sewage were collected, and the total suspended solids and the 5-day B.O.D. of each were determined. Ground garbage was then added to each sample in an amount equal to the total suspended solids in the sewage. The samples were incubated for five days at 20 deg. C., and the B.O.D. of each was determined. The analyses are given in Table III. In four of the tests the sewage had a lower B.O.D. with the garbage than without it. These inconsistent findings are undoubtedly due to the difficulty of getting closely consistent results when determining the B.O.D. of raw sewage. If the results of all fifteen tests are averaged, the garbage increased the B.O.D. of the sewage from 153.7 to 170.1 p.p.m., or 10.7 per cent. As garbage solids are generally far from being in the same putrefied condition as sewage solids, the B.O.D. of the former, as determined at the end of five days, should be much less than the latter. This is most likely the reason why the garbage did not materially increase the B.O.D. of the sewage. It is possible that if the sewage had been incubated for 40 or 50 instead of 5 days, the B.O.D. of the mixture would have been much greater.

As previously stated, corn husks were more difficult to grind than other kinds of garbage. Furthermore, they were not ground into a pulp like most of the other materials in garbage, such as scraps of meat, bones, and vegetables. The corn husks passed through the grinder as stringy fibers, some of which were 6 or 8 in. long. Some of this

TABLE III — EFFECT ON 5-DAY B.O.D. WHEN GROUND GARBAGE IS ADDED TO RAW SLUDGE

(Ratio of dry solids in garbage to total suspended matter in raw sewage was 1:1 by weight.)

Test No.	B.O.D. Raw Sewage Alone. P.P.M.	B.O.D. Raw Sewage With Garbage P.P.M.
1	126	122
2	67	93
3	67	81
4	68	138
5	67	91
6	85	79
7	95	104
8	90	94
9	100	126
10	191	198
11	180	261
12	236	243
13	294	306
14	339	318
15	301	298
Average	153.7	170.1

Incubation temperature 20° C.

material collected on the screens at the sewage works and was removed from the sewage. It is estimated that the screenings, which have averaged 1.4 cu.ft. per m.g. for the past five years, were increased about 50 or 55 per cent because of the presence of incompletely ground corn husks. It is understood that there are grinders operating at speeds as high as 3,600 r.p.m., which are especially designed to grind materials such as the above into a fine pulp.

The operation of the primary settling tanks was observed with considerable interest. As indicated by chemical analyses, the garbage did not increase the strength of the effluent from these tanks. There was, however, appreciably more scum formation on these units. Where tanks are provided with skimming equipment, it is likely that this condition would not be serious. As far as could be determined both by laboratory tests and by visual observations on the plant proper, the operation of the other treatment units such as the trickling filters, the humus tanks, the digestion tanks and the sludge-drying beds were not at all affected.

The grinding and the discharging of the peak production of garbage into the sewage at Baltimore during the six or eight-week period in summer, when the refuse incinerator is working at maximum capacity, so far seems to be much more economical and satisfactory than building additional incinerator capacity. It should be emphasized, however, that this conclusion applies particularly to Baltimore where the garbage is added to the sewage for a short period of time. The process should not be adopted in other cities until a careful study is made of all the factors involved. For example, nothing is known as to how the garbage would affect the activated-sludge process. Furthermore, it would be desirable to see what effect the garbage would have on sludge digestion where the material is added to the sewage day by day for a considerable length of time.

The treatment of ground garbage with sewage would seem to have more than an academic interest. In the first place, the cost of constructing and operating a grinding station is insignificant as compared with the cost of disposal by incineration or reduction methods. As compared with either of these processes, the odor nuisance should be much less. It should be possible to design a plant so that the only time that garbage would be exposed to the atmosphere would be when the trucks would discharge the garbage into storage bins connected with and above the grinder.

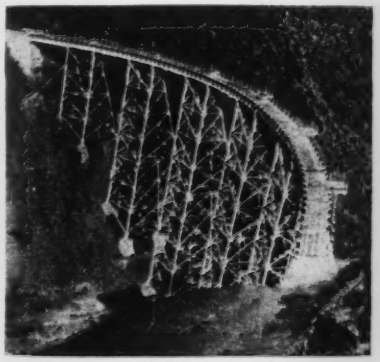
It should not be overlooked that the ground material will entail an increased expenditure at the sewage works in the form of additional treatment facilities and greater operating costs. It is estimated that the yearly weight of dry solids in the garbage at Baltimore is about equal to the dry suspended solids in the sewage. With the proper type of grinder it is believed that the increase in the screenings would be very much less than doubled. Additional facilities for sludge treatment such as digestion tanks and drying equipment would have to be provided. The tests made so far on the treatment of garbage with Baltimore sewage sludge indicate that digestion is just as rapid as when sludge digests alone. This statement is true, provided the proper environmental factors, particularly the right temperature and a sufficient quantity of seeding material, are present.

Considerable study of the problem remains to be done. The fertilizing value of the digested garbage and sludge is of special interest. It is understood that the process is awakening interest at other places where further laboratory investigations are being conducted. Within the next year or two, when more extensive operating results will have been collected at Baltimore, further details of the process will be available.

The grinding station was built under the general supervision of B. L. Crozier, chief engineer, department of public works, and Geo. E. Finck, sewerage engineer, and is operated under the direction of W. R. Straus, mechanical-electrical engineer.

High Railway Viaduct Built at 14,000-Ft. Elevation in the Andes

DIFFICULT and spectacular bridge building characterized the construction of the Polvorilla Viaduct on the Argentina State Railways in the Andes Mountains between the towns of Salta and Abra Chorillos. The viaduct, containing something over 1,600 tons of steel, is 733 ft. long and 235 ft. high above the streambed. It is built on a 656-ft. radius curve and on a 1⅜ per cent grade. Climatic and topographic conditions were so unfavorable that two years were required to complete the work, according to Don Eduardo M. Huergo, chief engineer of the Ferrocarriles del Estado, who has supplied this information. Among these conditions were low temperatures, strong winds, heavy snowfalls and the effect on men and machines of working at an altitude of nearly 14,000 ft. above sea level. Also, all materials had to be trucked 13 miles to the site from the nearest railhead.



RAILWAY VIADUCT in Andes Mountains, South America, which crosses Polvorilla Canyon at a height of 235 ft., is located more than 14,000 ft. above sea level.

The viaduct deck is supported by six steel towers varying from 88½ to 181½ ft. in height. Three of these towers have three legs, and three have six legs. Foundations are of concrete resting on solid rock. The tower spans are 46 ft. long, and the intervening spans 65 ft. long. The viaduct deck consists of iron pans about 10 ft. long, directly supported by the main beams. These pans are filled with concrete (1:3:5 mix), waterproofed with a coat of asphalt and topped with the stone ballast. Wood ties are used, separated by hardwood blocks in order to increase resistance against moving when trains are running on the slope of the viaduct. A footpath is provided along the side of the track, and safety platforms are available on each tower.

The design of the project was made by the state railways, and an engineer of the company was in charge of inspection and supervision of the field work. The railway company built the foundations and abutments at a cost of $110,000. Steel for the viaduct was supplied and erected by an Italian firm at a cost of $966,771 Argentine paper pesos.

Research to Rationalize Use of Cement-Macadam Construction

Field construction buttressed by laboratory research develops important fundamental principles governing construction of cement-penetration roads—Grout studies are novel and important

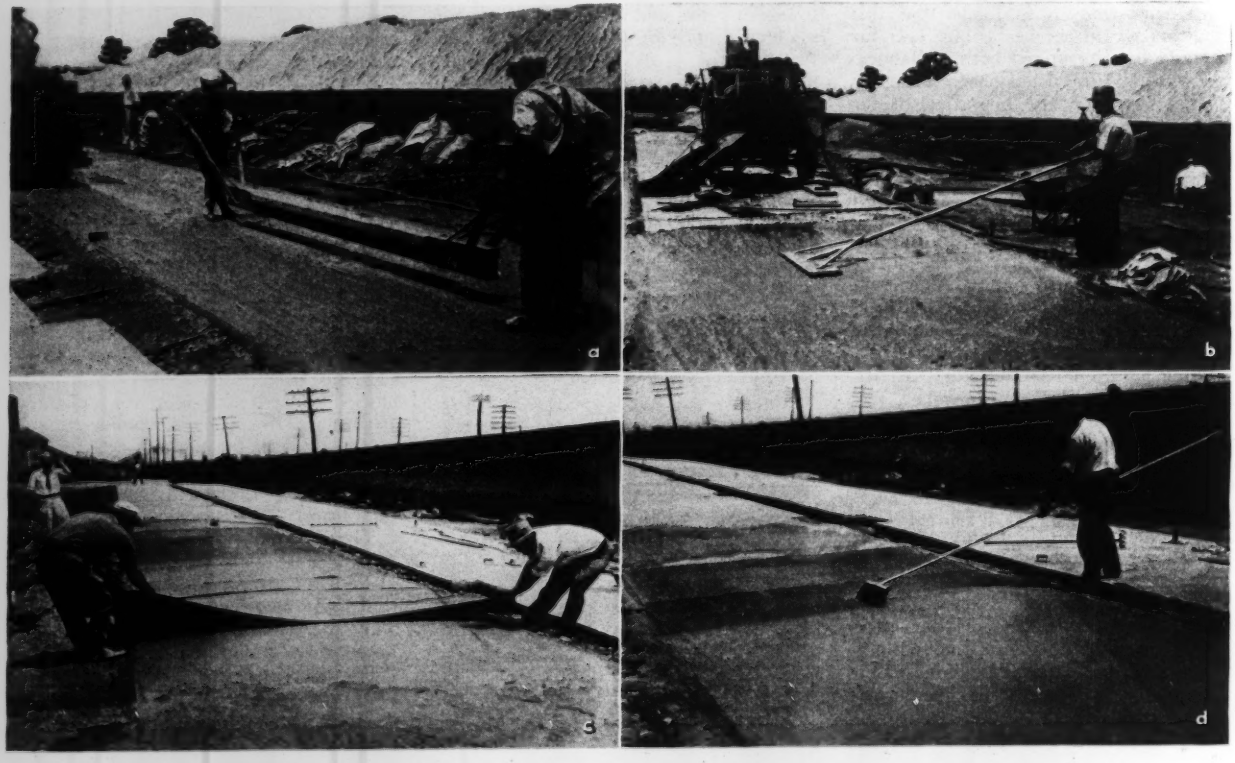
APPLICATION of fundamental research to cement-macadam road construction has been a notable development of the past year. Previously, beginning with the Hassam pavement of a past roadbuilding era, all knowledge has come from trial and improvement. This has been true of the last ten years of cement-macadam construction in other countries and of the reincarnation in the last two years in America of the old Hassam or broken-stone road penetrated with cement grout. Roads were built, records were made of methods and materials, results were observed, and the information gained was applied in succeeding cement-macadam road operations.

With many qualities of materials and many degrees of construction skill, the results, again beginning with Hassam pavement experience, had lacked reasonable uniformity. Then again, new standards of requirements for hard-road surface had been set up by roadbuiders and accepted as fact and custom by road users. These considerations, if the revival of the cement-penetration road was to play an increasing part in modern highway improvement, made greater control by rational methods necessary. To determine such methods, the Portland Cement Association last summer took steps to conduct a field and laboratory research into the fundamentals of kinds and sizes of aggregates, penetrating and binding qualities of grouts, subgrade treatments, and methods of compaction and curing as demonstrated by core borings and strength tests. This summary of principal findings is prepared from the original report made by E. M. Fleming and A. A. Anderson, manager and highway engineer, highways and municipal bureau, Portland Cecent Association, Chicago, Ill.

An experimental road was built consisting of two separated parallel 10-ft. pavements 600 ft. long. This 1,200-ft. pavement was divided by joints into 47 sections 20 ft. long, and 26 sections 10 ft. long; six 20-ft. sections and two 10-ft. sections were removed and replaced, making a total of 81 sections. These were grouped in 21 projects. Each project of 1 to 6 sections was designed to study the effects of one or more variables.

Particular features of construction subjected to test are described later; in general, the procedure was the ordinary one except that unusual precision was employed. The subgrade, a virgin soil, was shaped and rolled; side forms and bulkheads marking sections were set; aggregate was spread by hand because of the small areas of sections and was then rolled; grout was mixed in a small (7-S) concrete mixer and applied by spout with a pepper-pot end; the grouted stone was compacted and finished by the four processes illustrated

FIG. 1—FINISHING PROCESSES on cement-macadam test road: (*a*) irregularities reduced by longitudinal tamping templet; (*b*) long-handled float used following templet; (*c*) floated surface wiped longitudinally with burlap; (*d*) brooming gave final finish.



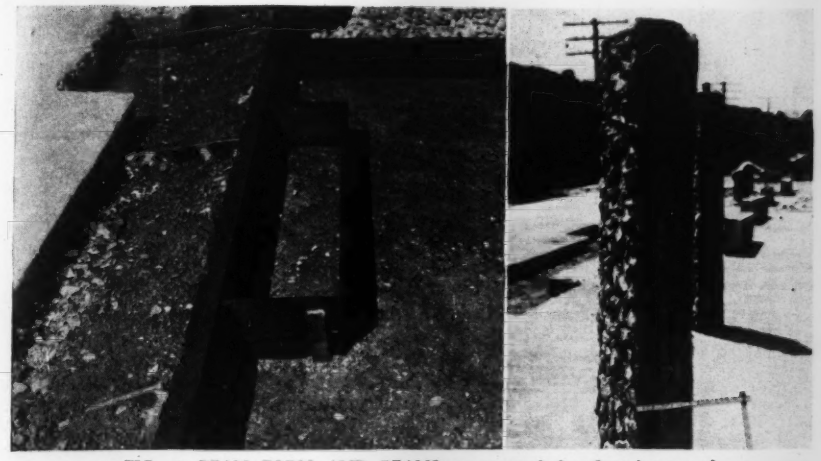


FIG. 2—BEAM FORM AND BEAMS as removed for flexual tests of cement-penetrated macadam slabs on the experimental road.

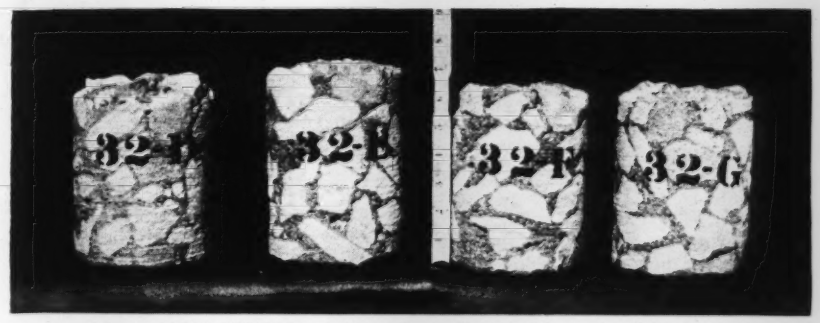


FIG. 3—CORES DRILLED to observe depth of penetration and to determine the compressive strength of the pavement blocks.

(Fig. 1), and the finished surface was cured by covering with wet burlap for 24 hours.

For tests, 86 beams were molded as shown by Fig. 2; these were 10 and 12 in. by 48 and 54 in. and the depth of the pavement. Also 251 cores 5¾ in. in diameter and 33 cores 4½ in. in diameter were drilled (Fig. 3). The beam and core-test results are considered later.

Study of aggregates

Seven sizes and three kinds of aggregates were used, as listed in Table I. These aggregates were such as can be ordinarily secured. The stone and gravel showed no objectionable crushing under eight rollings and even the limestone of 8 per cent wear proved suitable for penetration macadam. Under the same compaction the slag showed "appreciable crushing" which made penetration difficult. It is stated that "restricting rolling" or a "larger-size slag 1½ to 2½ in." will offer no difficulty to penetration. The studies of these aggregates were primarily to determine effect on penetration, on loss of aggregates pushed into the subgrade and on strength of slab.

Penetration—The type of aggregate was found to have no considerable effect on penetration except as it crushed under compaction. Gravel and crushed stone of corresponding size ¾ or 1 to 2 in. were equally readily penetrated. Size of aggregate had a decided influence on penetration and on the composition and consistency of the grout that would successfully penetrate. The smaller aggregate requires a more liquid grout to insure penetration.

Subgrade Loss—The amount of aggregate pushed into the subgrade was influenced by type, size, condition of subgrade and method of compaction. The third and last influences are discussed later under subgrade treatment and method of compaction. In respect to type, because of shape of particles and, or, because less rolling was required for equal sizes, there was less loss of gravel than of crushed stone or slag. Larger sizes suffered greater losses than smaller sizes.

Strength—With conditions otherwise comparable, the type of coarse aggregate had no outstanding effect on pavement strengths. Five sections of 1- to 2-in. limestone had an average modulus of rupture of 522 lb. per sq. in. at 7 days and an average compressive strength of 4,160 lb. per sq. in. at 28 days. On five comparable sections of ¾- to 2-in. slag the corresponding figures were 566 and 3,606 lb. per sq.in., and on five comparable sections of ¾- to 2-in. gravel they were 545 and 4,027 lb. per sq.in.

The effect of size was somewhat more apparent. Large size gave slightly higher pavement strengths than did the medium size. Oddly, the pavement made of the small size of both limestone and gravel had an average modulus of rupture somewhat higher and an average compressive strength appreciably lower than that made of the medium size. It is believed that this was due to less perfect penetration of these small materials, resulting in voids in the center of the slab. Being close to the neutral axis, the voids had less effect in flexure than under compression.

The slightly higher pavement strengths obtained with large (1½-3-in.) aggregate was offset by the higher grout consumption and greater subgrade loss. The small (¾-1½-in.) aggregates were difficult to penetrate satisfactorily. It is believed the best sizes of coarse aggregate for practical use are those ranging between ¾ to 2 in. and 1½ to 2½ in.

Study of grout flow

Successful penetration was found to depend primarily on a grout that would flow freely and without segregation into the coarse aggregate *at the time of placement*. Compaction after grouting was of little or no aid to penetration. A study of factors affecting the flow of grouts was, therefore one of the important features of the investigation, and the first task was the development of an apparatus that would measure the flow of grouts. Experiments developed a "flow cone," which consists of a funnel having a capacity of 221 cu. in., to the bottom of which is fitted a ½x1½-in. tube. It is shown in use in Fig. 4.

In making flow tests, the cone, rigidly supported with the top level, is filled with grout and allowed to settle 5 sec. for uniformity before flow is started. The net time in seconds required for the cone to empty is taken as an index of the fluidity of that grout. Typical flow curves plotted from results of such tests are shown in Fig. 5.

Effect of Sand and Water—Flow curves of grouts proportioned 1:2 by weight and made of the coarse, medium and fine sands are shown in Fig. 5.

TABLE I—PHYSICAL PROPERTIES OF COARSE AGGREGATES

Type	Size Range, In.	Specific Gravity	Unit Weight Lb./Cu. Ft. Measured Loose	Wear Loss, Per Cent	Toughness
Limestone	1½–3	2.66	92	6.6	10
Limestone	1 –2	2.64–2.69	86–89	4.6–8.0	13–16
Limestone	½–1½	2.64	87	...	16
Gravel	¾–2	2.67	95	2.9	..
Gravel	¾–1½	2.66	104	...	..
Gravel	½–1½	2.69	102	...	..
Slag	¾–2	2.42–2.57	85	6.7	..

FIG. 4—OPERATION OF CONE to determine flow characteristics of grout for penetration macadam.

Within certain limits the fluidity of the grout (measured by decreasing flow time) increases with the amount of mixing water. Also for the same fluidity more mixing water per sack of cement is required for the fine than for coarser sand grouts. This difference, however, becomes smaller for more liquid grouts and amounts to only about ¼ gal. per sack of cement between the three sands for grout having a flow of 21 sec.

Further study of the curves shows that the fluidity of grouts is increased but little by additional mixing water above that producing a flow of about 18 sec. Most important of all, still more water causes a stoppage or decreased rate of flow with the coarser sand grouts. This is caused by segregation resulting from the inability of thinner pastes to hold the larger sand particles in suspension. A similar effect is not evident for the fine sand grout within the limits of the test.

Observations show that objectionable bleeding of free water, which also bears a relation to the sand size, occurs before segregation has become sufficient to cause stoppage or a decreased rate of flow. The point at which free water segregates or bleeds from 1:2 grouts made of the coarse, medium and fine sands is shown in Fig. 6. The same chart shows amounts of mixing water required to produce usable rates of flow. The difference between the amounts of mixing water required to produce usable flows and those causing bleeding may be termed the safety factor for that particular combination. It is apparent from the chart that for any given fluidity the safety factor is greater for grout made with fine sands than with coarse sands.

It is believed that this safety factor should not be less than ½ gal. per sack of cement. Accordingly the chart dictates that the amount of mixing water used in 1:2 (by weight) grouts made of the coarse (0-4) sand should be limited to 7¼ gal. per sack of cement or that producing a flow of about 21 sec., and that similar grout made of the medium (0-8) sand should be limited to 8.5 gal. of water per sack of cement or that producing a flow of 18.5 sec. Obviously more fluid grouts should be made of fine aggregate comparable in grading to the fine sand of 0-14 size.

Observations of penetration and flow tests of grout in the field during construction determine, within rather definite limits, the fluidities that will readily penetrate the space between different sizes of coarse aggregate. It was found necessary to use grouts having a flow time of not more than 23 to 25 sec. to penetrate 1½- to 3-in. aggregate, not more than 20 to 22 sec. to penetrate ¾- to 2-in. aggregate, or not more than 17 to 19 sec. to penetrate ½- to 1½-in. aggregate.

Correlating the data in the two preceding paragraphs, it will be seen that 1:2 grout made of the fine (0-14) sand is suitable for use with either of the three sizes of coarse aggregate. Similar grout made of the medium (0-8) sand is suitable for ¾- to 2-in. or larger coarse aggregates, while similar grout made of the coarse (0-4) is suitable only for 1½- to 3-in. or larger coarse aggregates.

Requirements of grout for satisfactory penetration depends, therefore, on the size and shape of the spaces between the coarse aggregate particles, small-size coarse aggregate requiring more liquid grout than large-size aggregate. Grout can be made more liquid by adding mixing water but only up to the point of detrimental bleeding or segregation. This point depends on the size and gradation of the fine aggregate. Grouts made of fine sand can be made more liquid without segregation than grouts made with coarse sand.

Effect of Grout Proportions—Grouts proportioned 1:2, 1:2½ and 1:2¾ by weight were made of the medium sand, and grouts proportioned 1:2, 1:1½ and 1:1 by weight were made of the fine sand. It has been shown that 1:2 grout made of the fine sand is amply safe to use for penetration for the smallest aggregate used in the tests. Obviously richer mixes made of the fine sand will be amply safe for penetration. This discussion, therefore, will be confined to the mixes used with the medium sand.

Flow curves of these grout mixes are given in Fig. 7. It will be seen that the flow curves are symmetrical, the flow time decreasing in much the same manner for each mix as the amount of mixing water is increased, leaner mixes requiring more mixing water per sack of cement than richer mixes to obtain the same fluidity. It may also be seen that decreased rates of flow are obtained with amounts of water beyond that causing segregation. The point at which decreased flow occurs is influenced by the cement content, more liquid grouts being obtained with richer mixes than with leaner mixes before segregation occurs.

The point at which objectionable free water bleeds from 1:2, 1:2.5 and 1:2¾ grout mixes made of the medium sand is shown in Fig. 8. The same chart shows amounts of mixing water required to produce usable fluidities.

This chart, studied similarly to Fig. 6 on the effect of size and gradation of sands, shows that for the same fluidity the safety factor (before bleeding occurs) is greater for 1:2 grout than for the leaner mixes. Also based on a safety factor of ½ gal. of water per sack of cement, a 1:2 mix should be limited to a maximum fluidity corresponding to a flow of 18.5 sec., the 1:2½ mix to a flow of 19.5 sec. and the 1:2¾ mix to a maxi-

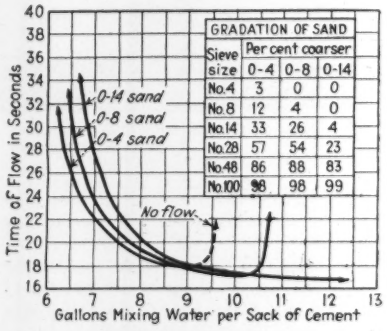

GRADATION OF SAND
Sieve size | Per cent coarser 0-4 | 0-8 | 0-14
No.4 | 3 | 0 | 0
No.8 | 12 | 4 | 0
No.14 | 33 | 26 | 4
No.28 | 57 | 54 | 23
No.48 | 86 | 88 | 83
No.100 | 98 | 98 | 99
0-14 sand
0-8 sand
0-4 sand
No flow
Time of Flow in Seconds
Gallons Mixing Water per Sack of Cement

FIG. 5—FLOW CURVES of cement grout made of coarse, medium and fine sands, with gradation analyses of the three sands.

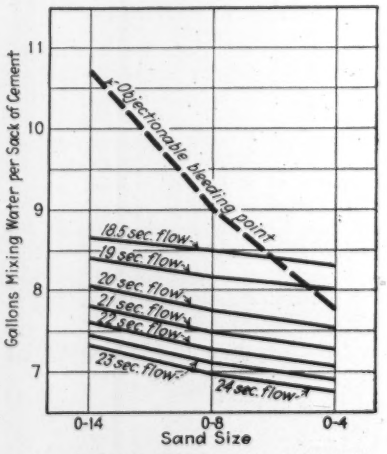


FIG. 6—RELATION between amount of mixing water producing usable flows and that causing objectionable bleeding. Grouts are proportioned 1:2 by weight and made from the coarse (0-4) medium (0-8) and fine (0-14) sands.

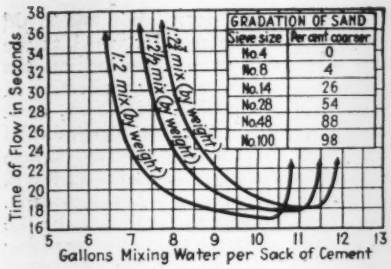


FIG. 7—FLOW CURVES for medium sand grouts of various proportions with gradation analysis of sand.

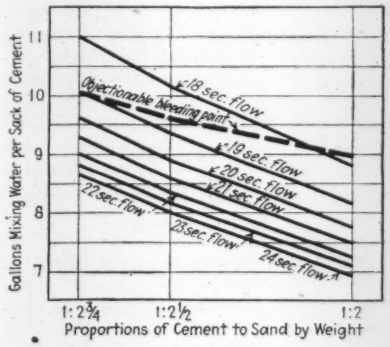


FIG. 8—RELATION between amount of mixing water producing usable flows and that causing objectionable bleeding for three grout proportions.

mum flow of 20.5 sec. Correlating these data with the fluidities required to penetrate different sizes of coarse aggregate, it will be seen that a 1:2½ is suitable for use only with ¾- to 2-in. or larger-size coarse aggregate. The maximum fluidity that can be obtained with a 1:2¾ mix is on the margin of that required to penetrate ¾- to 2-in. coarse aggregate, and for this reason should probably be limited for use with 1½- to 3-in. or larger-size aggregate.

Both the 1:2½ and 1:2¾ mix grouts made of the medium sand having an average flow of 20.3 sec. satisfactorily penetrated 1- to 2-in. and 1½- to 3-in. crushed limestone. It was observed, however, that the 1:2¾ grout was granular and difficult to handle, and it is believed that mixes leaner than 1:2½ should not be considered for use under average conditions of construction.

Effect of Compositions on Strength—A study of the strengths of pavement made with 1:2 grout shows that there is some difference in strengths obtained with grouts made of coarse, medium and fine sands. Pavements made with the medium sand grout developed the highest strengths and are followed in order by pavements made with coarse and fine sand grouts.

If a modulus of rupture of 500 lb. per sq. in. at 7 days is desired, the tests indicate that it may be obtained with a 1:2½ mix or surely with a 1:2 mix by weight. It is probable that richer mixes than this will seldom, if ever, be found economical for this type of construction.

TABLE II—COARSE AGGREGATE LOSS ON TREATED SUBGRADES

(Coarse aggregate 1-2 in. limestone; compaction by 5.6-ton roller; initial eight times over; final four times over

Section	Subgrade Treatment	Amount of* Treatment Material Per Cent	Stone† Loss Per Cent
1	None		12.9
2	One layer (1.3-in.) 1-2 in. limestone roller into subgrade (88 lb./sq. yd.)	17.0	0.0
3	1.6-in. crusher run limestone rolled into subgrade (119 lb./sq. yd.)	23.1	1.3
4	1.6-in. ½-¾-in. gravel rolled into subgrade (121 lb./sq. yd.)	23.8	0.0
5	2.1-in. limestone screenings (162 lb./sq. yd.) mulched into grade and rolled (screenings 87%—Clay 13%)	32.0	7.9
6	2.5-in. torpedo sand (171 lb./sq. yd.) mulched into grade and rolled (sand 69%—clay 31%)	34.7	16.0

* Weight of treatment material divided by weight of coarse aggregate for pavement.
† Weight of stone pushed into subgrade divided by total weight of coarse aggregate for pavement.

Subgrade treatments

Both the type and condition of the subgrade influenced the amount of coarse aggregate (subgrade loss) pushed into the grade during compaction. Subgrade losses obtained on the untreated subgrades are believed to be above the average because of the character (virgin soil) of the subgrade and the type of soil (heavy clay). Roads built on firmer soils or old traveled roadways would have some, but materially smaller losses, while those built on old, well-compacted gravel or macadam roadways would have no subgrade loss.

A study was made to determine the methods of handling extremely soft subgrades. The pavement was purposely placed on the treated and untreated subgrades wet by rain and kept wet by sprinkling. The treatments and accompanying subgrade loss are shown in Table II.

The table shows that the treatment material used ranges from 17.0 to 34.7 per cent of the total weight of the coarse aggregate spread. This amounts to considerably more than the usual loss where the subgrade was not treated. Obviously, it would not be economical to treat subgrade except where the treatment material is appreciably cheaper than the coarse aggregate. However, treatment of subgrades has other definite advantages in addition to preventing loss of coarse aggregate. A pavement of uniform and predetermined depth is assured, and a truer surface having better riding qualities may be attained on a uniformly firm subgrade.

Methods of compaction

Three methods of compaction were used: rolling, hand-tamping and vibration. Compaction of ungrouted aggregates will be spoken of as initial compaction, and that of grouted aggregate will be termed final compaction.

Rolling—A 5.8-ton tandem roller was used on 50 sections, and a 3.3-ton tandem roller was used on six sections. Neither roller could be operated on ungrouted gravel aggregate, but both were used successfully in final compaction on gravel.

Initial rolling, where practicable, reduced the voids and therefore the grout and cement requirements. It keyed together and stabilized the aggregate while the subgrade was dry so that it was easier to maintain a true surface under final compaction when the subgrade had become wet by water escaping from the grout. It reduced the amount of aggregate pushed into the subgrade. The light roller smoothed the surface as effectively as the heavier one, but its use resulted in less reduction of voids, without a corresponding reduction in amount of aggregate pushed into subgrade.

Rolling after grouting smoothed the surface and brought up sufficient grout to cover the aggregate. It also closed the voids left by the excess water escaping from the grout and in this way increased the strength of the slab. These functions were best performed when rolling was delayed as long as harden-

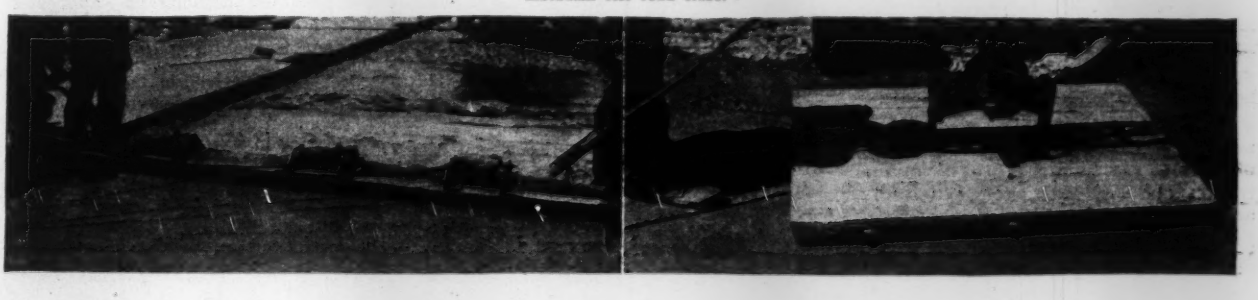


FIG. 9—TWO TYPES of vibrating devices used in compacting cement-penetrated-macadam test road slabs.

TABLE III—AVERAGE COMPACTNESS FACTORS FOR DIFFERENT COARSE AGGREGATES AND METHODS OF CONSOLIDATION

Initial Compactness by	Finale Compaction by	Crushed Limestone	Crushed Slag	Gravel
5, 8-ton roller	5, 8-ton roller	1.14	1.14	....
None	5, 8-ton roller	1.05	1.08	1.06
3, 3-ton roller	3, 3-ton roller	1.06	....	....
None	3, 3-ton roller	1.02	....	1.02
Vibration	Vibration	1.04	1.06	1.10
None	Vibration	1.05	1.10	1.05
None	Hand-tamping	1.02	....	1.04

TABLE IV—REPRESENTATIVE STRENGTHS OF CEMENT-PENETRATED MACADAM BEAMS AND CORES

Method of Compaction	Modulus of Rupture, Lb. Per Sq. In. 7 Day	Modulus of Rupture, Lb. Per Sq. In. 28 Day	Compressive Strength, Lb. Per Square Inch. 28 Day
5, 8-ton roller	580	696	4,114
Vibration	550	670	4,014
3, 3-ton roller	429	626	4,234
Hand-tamping	388	567	3,891

ing of the grout would permit. Final rolling required from four to ten passes of the roller. Gravel required less rolling than slag or crushed stone.

Hand Tamping—On two gravel and one limestone sections the aggregate was spread and grouted without initial compaction. After grouting, the surface was tamped over three to four times with the longitudinal tamping templet. This produced little compaction, but the pavement leveled up nicely, and the surface was as satisfactory as on other sections. As there was no reduction of the voids, the grout and cement consumption was high. To offset this, the coarse aggregate requirement was less, because of reduced compaction and no loss of material in the subgrade.

Vibration—By vibrating the ungrouted aggregate little compaction resulted and the grout requirement was not reduced. The same equipment, three vibratory motors on a heavy wood screed (Fig. 9), when used at the right time, about the same interval after grouting as indicated for rolling, was effective in producing good surfaces and strengths. For practical use the screed should be mounted on a finishing machine.

On other sections a puddler, consisting of a 3x4-ft. platform on which was mounted one vibratory motor (Fig. 9) was used for final compaction and to aid penetration. This puddler, used at the time the grout was deposited on the coarse aggregate, was very effective in promoting penetration. However, as it could not rest on the side forms as did the screed, it produced a wavy surface so firmly keyed together that later use of the tamping templet did not smooth it. The grout brought to the surface by the use of the puddler so soon after grouting was too liquid to cover the aggregate, and a good finish could not be obtained.

As with hand-tamping, reduced compaction obtained with vibration increased the grout requirement and reduced the coarse aggregate requirement.

Amount of Compaction—In comparing amount of compaction produced by different methods, it is convenient to use a "compaction factor" that equals the ratio of volume of coarse aggregate before initial compaction to its volume after final compaction. This factor for varying conditions is shown in Table III.

Strength tests

A general conception of the strengths obtained may be had from Table IV, which gives average strengths of sections of 6-in. nominal thickness, made of all coarse aggregates and grout proportioned 1:2 (by weight) of medium (0-8) sand under varying methods of compaction.

General Contractors Extend Scope of Organization

Associated General Contractors change association laws to give privilege of membership to all general contractors and increase budget at annual convention to provide for recruiting service

AN OUTSTANDING attendance of leaders in contracting characterized the annual convention on Jan. 29, 30 and 31 in Washington, D. C., of the Associated General Contractors. Leading building, heavy works and highway contractors were attracted to the meeting by interest in the construction code situation and the problem of association organization changes to meet the requirements of code participation. Incidentally these members were cheered, before the convention closed, by the announcement that the general code published in our last preceding issue had been signed by President Roosevelt. The papers and addresses included several by high officials of the Public Works Administration and by contractors, engineers and architects of national prominence.

In compliance with a request of the National Recovery Administration for a change of membership requirements to conform to code government, the association adopted the following changes in its by-laws and rules of procedure. Briefly it was voted to suspend, for the duration of the Divisional Code Authority as now organized, Sections 1, 2 and 3 of the by-laws and Articles 2, 3 and 4 of the rules of procedure, and to add Section 7 to the by-laws and Article 22 to the rules of procedure as follows:

Sect. 7—Membership in the Associated General Contractors of America shall be open to any general contractor as that term is defined in the General Contractors' Division, Chapter II, of the Code of Fair Competition for the Construction Industry and who shall agree to abide by the Governing Provisions of the association.

ARTICLE 22

Sect. 1—An applicant shall not be rejected for membership in the association except for failure to show evidence showing applicant to be a general contractor as defined in Chapter II of the Code of Fair Competition for the Construction Industry, the failure to remit with application of the national service fees for the current year or failure to subscribe to the Governing Provisions of the association.

Sect. 2—Members may be held to be delinquent and suspended from the privileges of membership where the national service fees are more than six months in arrears. A delinquent member shall be restored to all the privileges of membership upon payment of all national service fees due.

Sect. 3—The ground for suspension or expulsion shall be non-compliance with the code or non-payment of the national service fees when over six months in arrears.

In order to parallel the subdivisions created in Chapter II of the Code of Fair Competition for the Construction Industry, the association approved changes in Article 12, "Occupational Divisions," to read as follows:

Sect. 1—To provide a forum for discussing matters that concern particularly the various kinds of construction and to promote the interest of members engaged therein, divisions of the membership, designated as occupational divisions, may be established by action of the board. Occupational divisions established are Building Division, Heavy Construction and Railroad Contractors' Division and

the Highway Division. The board may alter or add divisions as it may determine to be necessary.

CWA activities

An account by Harry L. Hopkins, Administrator, Civil Works Administration, of employment and construction activities under this division of the Recovery Act expenditures, developed active questioning from the floor. Stating that in March, 1933, the people on relief rolls were 4,000,000 families, or some 20,000,000 persons, Mr. Hopkins pointed out that the extent of relief being afforded was about 50c. per family per day. Delay of the PWA funds to function in prompt relief of unemployment instigated the CWA as a means of relief. It was decided to use half a billion dollars with the object of putting 4,000,000 men at work, half to be selected from the relief rolls and half from the self-sustaining unemployed. All work, it was decided, was to be on public property.

Speaking of results, Mr. Hopkins said that the plan was to have all the 4,000,000 workers drawing pay in 30 days. It actually took 38 days for the job. In that time 4,000,000 men were drawing pay on about 400,000 projects; there was not one of 3,300 counties without a job. The larger number of the projects were secondary roads and city streets. There followed in order repairs on public buildings, extensions of sewers and water mains, park and playground improvements and then lesser work. It was known that the efficiency was of many degrees, on some operations pretty low, and also on some remarkably high. On the average it was creditable. On the present funds the CWA work would cease about Feb. 15. It was being asked that further funds be provided, with the idea of demobilizing all CWA forces by May 1.

The discussion centered on possible time of continuation of CWA work, on efficiency and on percentage of payment for materials. In reply to a question by A. E. Horst, Mr. Hopkins stated that demobilization by May 1 was based on increasing absorption of men by business pick-up, on the natural seasonal increase of spring and summer and on the fact that employment by PWA work would be getting into full swing by May. Commenting on CWA work in New York, F. H. Cranford considered that about 5 per cent efficiency was being averaged. He also criticized the small percentage being allowed for materials. Positive denial was made by Mr. Hopkins of any such inefficiency; he also stated that, the country over, 30 per cent had been allotted for materials.

Reporting on the work of an A.G.C. committee to devise a form of contract for CWA work, C. E. Lott, of John F. Casey Co., Pittsburgh, Pa., outlined a contract which provided a fee for plant and supervision and payment of cost of labor and materials, both to be selected and controlled by the government. It was indicated that this form of contract would also apply to normal day-labor work. General opposition developed in discussion to formal approval, such as a recommended special contract would indicate, of CWA work by the association. On motion of A. E. Horst it was voted to commend the committee for its work and to lay the report on the table.

Heavy construction division

With one session given up to consideration of supplementary code provisions, this division had a program of six papers. Writing on the outlook for railway construction, Charles V. Burghart, of Bates & Rogers Construction Co., Chicago, Ill., saw little work in prospect for contractors who had specialized in railway work. New lines and extensions were not required and, with present reduced traffic, station and terminal development would serve and must do so until traffic and finances had greatly improved. About the only present activity was grade-crossing elimination, and this, which is being done with Recovery Act funds, was mostly being planned and executed by state highway departments and not by railways.

T. A. Scott, of Merritt, Chapman & Scott Corp., New York, read a paper on the historical development of coast and coastal waterways construction. Gradually, so far as federal improvements are concerned, the work had become a function of the Corps of Engineers, U.S.A., and they possessed the plan, so far as any plan existed, and most of the amassed information and data. Aside from federal work it could be said that comprehensive planning simply did not exist. Private, municipal and state coast improvements were undertaken as the necessity became critical and the money was had.

In inland waterways construction, C. E. Lott, of John F. Casey Co., Pittsburgh, Pa., referred briefly to the PWA work inaugurated on the Mississippi River and its tributaries, and H. J. Sternberg, Sternberg Co., St. Louis, Mo., pointed out that this year would see main-river levee work on the lower Mississippi virtually completed. Chief interest, however, centered in a discussion on combating day labor by Lynn S. Atkinson, Jr., Los Angeles, Calif. Stating that a year and a half ago, with some $200,000,000 of large public projects in southern California all lined up for day labor, the Southern California Chapter of A.G.C., he said, had turned the work to contract construction. The means primarily had been for leading contractors to inject themselves into the activities of virtually every civic and business association and sell it on the principle of keeping government out of competition with business. Secondarily the association had actively cooperated with the public works agencies in their efforts to project and finance public works. On the one hand, the association had recruited a following, and on the other had upheld the hands of public officials in their works financing plans.

Building division

During an all-day session of this division at which the average attendance was 70 members, addresses on the following subjects were presented. Discussing real property inventory, Dr. Willard L. Thorpe, director, bureau of foreign and domestic commerce, U. S. Department of Commerce, explained the purpose of the work and further advised that 65 typical cities widespread throughout the country were conducting this intensive survey of existing structures now housing people or designed to house people; and that local enumerators and investigators were obtained under the CWA plan of putting people to work. A digest of the result of this survey will probably be available within about six weeks.

Fred F. French, president of Fred F. French Co., New York City, described in detail the advantages of his system in arranging for a 50 per cent mortgage on a building, marketing the remaining 50 per cent to the general public in the form of preferred stock. R. H. Shreve, of the firm of Shreve, Lamb & Harmon, architects, New York City, spoke on the plan of organizing for slum clearance in New York City, and Thomas Bentley, president of A. Bentley & Sons, Toledo, Ohio, addressed the meeting on the subject of day labor.

J. A. Caffrey discussed bill H.R. 6460, to amend the Home Owners Loan Act of 1933 by adding a new section to authorize home mortgage loans and to appropriate the sum of $500,000,000 therefor. After discussion, a committee was appointed to draft a resolution for the consideration of the convention resolutions committee. The resolution read as follows:

"Resolved, that the Associated General Contractors of America, in convention assembled, do hereby respectfully urge the early consideration of such pending legislation and request from all members of both houses of Congress favorable action upon such federal lending."

D. T. Webster, chairman of the executive committee of the Building Contractors Code Committee, gave a brief résumé of the history in connection with the preparation of a supplemental Chapter II (a) of the Code of Fair Competition for the Construction Industry, explaining that the committee had been working on this development of the subdivisional code provisions but was unable to consummate the work until such time as the basic code has been approved. W. F. Austin, of Detroit, a member of the code execu-

tive committee, supplemented the chairman's remarks and went further into detail with regard to the formation of the code and advised that due consideration had been given to the many requests, recommendations and suggestions from members from all over the country.

The division elected W. F. Austin, of Detroit, as chairman of the division and L. T. Shackleford of South Carolina as vice-chairman, for the year 1934.

Highway contractors' division

In discussing labor regulations on National Recovery Act highway projects, Fred I. Rowe, of the W. L. Johnson Construction Co., Hicksville, Ohio, criticized the local residence requirement as unjust to many old and valued men of contractors' organizations. Under the necessity of recruiting labor almost entirely from county relief lists, the contractor can use only a skeleton organization of a few experienced superintendents and foremen. The local labor restriction, he pointed out, imposes a particular hardship on skilled labor, including operators of heavy machinery. The highway contractor, under present conditions, must face the reality of building up a new construction organization of workers requisitioned from local relief lists. Under these conditions he cautioned against starting work at full speed; instead, it has been found preferable to begin operations on a small scale and build up gradually, thus avoiding the necessity of laying men off during the early stages of a contract. Mr. Rowe suggested that contractors should be allowed to retain in their organizations a sufficient number of skilled mechanics and machine operators, even though these men be non-residents of the locality in which the work is located. Good results were reported from the plan of establishing a training course and testing period of three or four days for all new and untried machine operators obtained from local lists.

Roy F. Britton, director, National Highway Users Conference, presented an estimate indicating that during 1933 approximately $200,000,000 of highway funds had been wrongly diverted to other uses.

Thomas H. MacDonald, chief of the U. S. Bureau of Public Roads, announced that about 60 per cent of the $400,000,000 emergency highway program authorized by the Recovery Act was under contract, and approved projects, constituting 70 per cent of the program, totaled 5,723, of which only 863 were for day-labor operation. Mr. MacDonald questioned the desirability of the existing regulation requiring local residence for skilled labor employed on an emergency highway contract. He favors a change in the rules to permit contractors to employ not only superintendents but also machine operators, irrespective of their place of residence.

Present regulations governing computation of maximum hours are unsatisfactory, according to Mr. MacDonald, because they are based on conditions in indoor, instead of outdoor, employment. While 130 hours of labor per month are allowable under present restrictions, the actual average which weather and other seasonal restrictions have made possible is only 114 hours per month.

Motor-vehicle revenue, if devoted exclusively to highways, would provide an annual fund of about $1,000,000,000, which should be used, according to Mr. MacDonald, to provide continuous employment for highway workers. The peak of the present $400,000,000 emergency highway program will be reached late in August of this year, with 275,000 men directly employed. From Sept. 1 there will be a decline in employment on highway construction unless funds are provided to continue the program. We shall need, Mr. MacDonald believes, an additional emergency appropriation for next year and a resumption of regular federal aid in 1936.

R. E. O'Connor, of the firm of J. C. O'Connor, Fort Wayne, Ind., was elected chairman of the highway contractors' division for the current year.

PWA Administrator makes an appeal

Speaking before the full convention on Jan. 31, Harold L. Ickes, Secretary of the Interior, Administrator of Public Works under the Recovery Act, appealed to contractors to hold to the highest traditions of their business in carrying out their public work.

The first phase of the public-works program, he said, has been closed with the allocation of the money. "We are now entering the second phase, and it is because of the important part that the contractors of America will play in this second phase that I talk to you."

Let us start, he said, with the premise that these public-works funds are a trust fund. The Public Works Administration has tried to allocate it wisely and for the best interests of the whole country. It has guarded against corruption and graft and done everything within its power to prevent waste. But the real test is just ahead, and that is where contractors are to play a leading part. Will they be as careful and scrupulous in the expenditure of such portions of this money as may be entrusted to them as the government has been in allocating the money? How loyally, faithfully and patriotically contractors will perform their duty the next few months will disclose. There will be failures, of course.

"I am a lawyer," said Mr. Ickes, "and I know that there are honest lawyers and that there are crooked lawyers. I know that there are lawyers in the twilight zone. So, having said what I have about my own profession, I feel that I can with good grace sound a warning to the contractors."

The government holds to the view that every man who enters into a contract to build a public work under the PWA program is entitled to a fair profit in return for work honestly and faithfully performed. But it cannot subscribe to the theory that a contractor, even if he can get it, is entitled to more than a fair profit. Continuing Mr. Ickes said: "I cannot pretend to catalogue all the devious ways by which the public can be overreached in matters of this kind. I do not pretend to know all of these various methods or in exact detail how they work. But I do know that the government realizes that a heavy obligation rests upon it to protect this fund from being dissipated for improper purposes. It is our intention to inspect the works, to see that they come up to specifications. Our engineers will be watching every job as it progresses.

"Just as when I denounce a certain class of lawyers I do not refer to more than a very small minority of that honored profession, so when I refer to certain reprehensible practices in the contracting business I am not indicting an entire class. I know from my own experience, limited as it has been, that there are contractors as honest and as conscientious as can be found in any other calling or profession. You contractors, associated together as you are in voluntary organization, national, state and local, have the solution of this matter in your own hands. You owe it to yourselves not to permit any unscrupulous contractor to cast a stigma upon your group.

"Thousands of carefully selected public-works projects will go into construction shortly, and each of them will provide work both on the jobs themselves and in the quarries, mines, mills, factories and railroads back of the jobs. We must all join in protecting and cherishing the men working, and we must guard the projects themselves, for public works is the wheel-horse in the recovery team that the Administration has harnessed together to pull us out of the valley of despair."

Federal-aid housing

The resolution previously noted as adopted by the building division for federal aid to home building and renovation was later adopted by the full convention, with the additional requirement that the law should be worded to guard quality of construction.

Formation of a government housing corporation as a re-employment measure was recommended by Henry I. Harriman, president of the United States Chamber of Commerce. "To re-employ the 4,000,000 workmen formerly employed in the capital brick industries," said Mr. Harriman, "I would suggest formation of a government housing corporation to encourage private capital to enter the low-cost housing field."

Mr. Harriman suggested that low costs be accomplished through standardization of building equipment units.

Letters to the Editor

Safe Welding Practice

Sir—In the report of the Tiverton storage-tank failure, published in your issue of Dec. 14, 1933, p. 720, I find the interesting conclusion that "Large welded tanks should not be calked while filled." In the interests of safe practice in welded structural work, this statement should be modified. Small tanks also should not be calked while filled. In short, *no tank whose joints are welded should be calked.* We have calked pinhole leaks while making pressure tests of welded tanks, but this is only allowable for laboratory tests. If the tank is to be used in service, the defect should in every instance be chipped out and rewelded.

The same report states that "Better field inspection of welding is necessary." I am convinced that the most practical way to get satisfactory welded structures is to qualify the welders, both before the work is begun and at periodic intervals, say every six months. The welder should also be watched while working, and of course the tank should be inspected after completion. It is well established that welders who have been qualified will produce reasonably uniform results, as shown by the report of the Structural Steel Welding Committee of the American Bureau of Welding, September, 1931, in which the average dispersion of strength of test coupons for Class I welders was 4.35 per cent, and the conclusion was reached that "Test results indicate that welders who have attained the qualification results of Class I may be expected in commercial practice to produce welds of a strength within 12 per cent of a general average. . . . The committee considers this to be a satisfactory degree of uniformity."

Your article also recommends "more conservative design" in view of the "newness" of welding. Undoubtedly more conservative design is desirable than has been used in some tank work, but this is not because of the newness of welding. In some instances horizontal joints have been made as lap joints, with either one or two fillet welds. It is impossible to assign any particular value of strength to a lap joint having only one fillet weld. Why should not every lap joint be welded with *two* fillet welds, one at each edge?

The fact that the tank leaked would indicate that unless a crack developed through the weld metal there was no fusion between the weld metal and the plate. With poor workmanship this sometimes happens. In one welded tank that failed, pieces of weld metal 1 or 2 ft. long were later picked up; these sections of fillets were evidently not attached to either plate, which means that the weld metal was simply a casting that had been made in a metal mold.

Some of the recommendations reported in the article are questionable. For example, recommendation 3 is in favor of X-ray inspection of welds. Why should the report imply that welding cannot be used with confidence until some trick test is devised? The results of strength tests on joints made by a particular welder and of specimen joints of the design and material to be used in the structure are definite. On the other hand, X-ray tests are indefinite, and their value depends upon establishing the relation between the X-ray photograph and strength test results. Their relation may vary from job to job. An X-ray of a lap joint may not show anything wrong, even though there is complete lack of fusion of the weld metal to the plate, unless an appreciable opening exists between the two. The strength of the joint might be zero, although X-ray examination showed no defect.

Electrical conductivity and magnetic tests also do not directly determine the strength of a weld joint. They are awkward to use in the field, require skilled manipulation and are expensive. It is difficult to see why qualification tests and tests of actual welded joints should be ignored in favor of these uncertain and difficult test methods. X-ray and other tests are useful as additional assurance after welders have been qualified and sample joints tested for strength and other physical properties, but I question whether it would be proper engineering practice to depend on them exclusively, particularly in the field-welding of a tank.

The last two recommendations of the article are obviously good. They apply, however, as much to riveted as to welded tanks.

While considering the safety of welding, particularly as applied to tanks, it is worth remembering that whatever the factor of safety or the quality of the plates, the welded job can be made stronger and will have less leakage than a riveted job. Trouble from leakage of oil tanks is not unknown, while a properly designed and constructed welded tank is tight and stays tight.

H. L. WHITTEMORE,
U. S. Bureau of Standards.

Washington, D. C.,
Jan. 4, 1934.

The Geodetic Survey's CWA Work

Sir—A big surprise to the writer is the complacency of most private engineers who sit idly by and see the U. S. Coast Survey take all the bread and butter out of their mouths.

The privately established engineer should be getting all the CWA jobs on a reasonable basis. The CWA work directed by the Coast Survey is surely a makeshift, and the plans and surveys will all be discarded. And discarded mostly because they are not in harmony with the established facts as possessed by the private engineer.

Why does the private engineer sit and say nothing? Why doesn't he talk and fight and insist on some rights and privileges for the taxes he pays? Are our servants in Washington all as autocratic as the Coast Survey and the Geological Survey?

The Coast Survey pays $3,000 for a special theodolite of its own design—heavy and cumbersome and slow, and with circle graduated in Switzerland with errors of 18". The private engineer performs equally accurate work with an instrument of United States make, costing about $500. Surely these bureaus have gone far astray in their competition with the private U. S. maker of reputable theodolites.

"BUILDER."

Boston, Mass.,
Jan. 10, 1934.

In reply to this criticism, the Director of the Coast and Geodetic Survey gives the following information:

Sir—I have read with interest your letter of Jan. 16, 1934, in which you quote extracts from a correspondent who criticizes our CWA work.

I would be profoundly shocked and grieved to learn that our work was taking all the bread and butter out of the mouths of private engineers. For the primary purpose of that project is to provide bread and butter to thousands of unemployed engineers by engaging them on useful public work until such time as a recovering nation can re-absorb them into their normal occupations.

However, in justice to your correspondent I must admit that a mere statement of purpose is not sufficient. The wrong method of execution can defeat the most laudable purpose. What, then, is our method?

For years the Coast and Geodetic Survey has been engaged on a federal program of control surveys which is spreading over the country networks of permanently marked points of known elevation and known directions and distances between any two points. The program contemplates a 25-mile spacing of the nets; that is, when the work is finished, in general no point in the United States will be more than about 12½ miles from one or more of these points.

The purpose of these surveys is to furnish a tool for use by engineers on every project requiring accurate knowledge of distances, directions and elevations. They control the accuracy of the work done and insure adequate accuracy at greatly reduced cost. They make possible the coordination of any project with others adjacent, whether executed concurrently or at different times. Engineers will so readily appreciate these

values that I shall not elaborate on them.

Obviously, those values are limited at present by the wide spacing of the federal nets. The engineer cannot afford to run a 12-mile traverse or line of levels in order to carry the control to his local project. Therefore, from the first the program has contemplated that other federal, state and local agencies, as incidents to the execution of their respective engineering projects, would establish intermediate points, and thus there would gradually come into being a closely spaced network which eventually would be within reach of any project.

Our CWA project is limited to establishment of these intermediate points. Very briefly, surveying parties, starting at a known point in the federal net, run lines of traverse and leveling along highways or railroads to close on a second known point, and, en route, establish marked points at suitable intervals. The work is accurate, giving results of permanent public value, yet so simple that any competent engineer after a few hours or days of practice can perform it efficiently.

Admittedly, it is primarily a work-relief project. About 85 per cent of the total cost goes to pay of personnel. We have about 9,500 men employed. I do not know precisely how many of them are engineers, but I believe it is more than half of the total. With the help of American Engineering Council, the American Society of Civil Engineers and all other agencies affiliated with Council, we have tried to get word to every unemployed engineer that a job is available to him if he wishes to accept it.

Not all those jobs are of professional grade. We have hundreds of competent engineers serving as rodmen, chainmen, recorders, and even mixing concrete and setting station marks, and they are glad to get the job. In contrast to the viewpoint of your correspondent, I quote from a letter from one of our state supervisors:

> This is certainly a heartening work, because some of these young engineers who have not had any work for a couple of years are now receiving pay checks. They were very thankful, when some came in with tears in their eyes, to find that they could get a job.

No statement about this work would be complete without a word of appreciation of the 48 men—each an outstanding engineer in his own state—who have taken charge of the respective state projects. They took the jobs in order that they might aid their less fortunate fellows, and they have given unreservedly of themselves in order to make the projects a success. I do not believe that one of the 48 would say, or even feel, that we have been autocratic or dictatorial, or, in any matter within our discretion, have shown any disposition other than to give them every possible backing and support from Washington.

I shall deal very briefly with the matter of theodolites. Good instruments are a good investment, because they reduce the cost of field work. As a result chiefly of improvements in instruments and equipments, we are carrying on our principal functions today at unit costs just about half what they were in the pre-war period. We have designed most of our highest-grade instruments, and usually have built one or more samples in our own instrument shop. With these to serve as models, we then procured them in quantities from instrument makers in this country, although in some cases we have had to have the circles graduated in Europe. We have purchased some instruments in Europe. However, we invariably give preference to United States products if they are obtainable at a cost not unreasonably greater than similar products of foreign manufacture.

Our present standard theodolites weigh 31 to 34 lb. each. For the present emergency work we are using some heavy, cumbersome instruments, to which your correspondent refers. Normally, however, these have been obsolete for perhaps half a century, and their contrast to our modern standard merely serves to emphasize the progress we have made in instrument design.

R. S. PATTON,
Director, U. S. Coast and Geodetic Survey.
Washington, D. C.,
Jan. 24, 1934.

Wanted—a Highway Association

Sir—I note the editorial in the issue of Feb. 1 entitled "Wanted—A Highway Association." In this editorial there is emphasized the need for promotional work to solve the various problems facing the highway field and to educate the users of the road to their true economic value and the cost to them if the highway building and maintenance programs are not continued in an orderly fashion.

It is important to emphasize the logic of stopping the diversion of the gas tax and to show the necessity for its use for the purpose originally intended; in all of these general suggestions the writer heartily agrees.

It is also logical that there be created a closer cooperation between the units interested in the solution of the foregoing problem so that greater efficiency can be gained toward obtaining the desired results; but because of close contact with the activity of the American Road Builders Association for the past fifteen years, I cannot agree with your statements as to the present disorganized status of this association, which has done so much in the past toward the establishment of these principles.

It is true that their appropriation for the coming year has been pared down. It is true that perhaps the efficiency has been decreased. It is also true that perhaps on the surface the morale may have been lowered, but theirs is a sales problem, and may I suggest the question—"Is there any sales organization in this country today that has not suffered in a similar way due to the months of depression through which we have passed?"

It has been the effort of all companies to operate as efficiently as possible on a materially reduced budget, and this is merely what the American Road Builders are attempting to do at the present time. It is my personal opinion that even on this reduced budget, which, upon greater cooperation of engineers, manufacturers, contractors and materials men can be increased, they will do a major work merely through the elimination of problems which they have attempted to solve and which were not closely allied to the present picture, and because their activities this year, through better direction of effort, will prove to be more efficient and to the point.

I am in agreement with your thought that some plan be developed whereby a better coordination of the individual organization efforts can be worked out, but I do wish to take this opportunity of expressing a personal opinion as to the possibilities of accomplishment by the American Road Builders that is in contrast to the thoughts expressed in your editorial.

LION GARDINER,
President, Lakewood Engineering Co.
Columbus, Ohio,
Feb. 6, 1934.

An Aid to Public Speaking

Sir—During the past four or five decades I have frequently called attention, both orally and in print, to the fact that engineers in general are very weak on public speaking, and, in consequence, our profession does not occupy in the community the high position that its importance merits. Others, too, especially of late years, have been harping upon this lamentable condition; but very little has been done to overcome it, or even to suggest feasible methods of so doing. It has been advocated that engineers put aside their unwarranted modesty, push themselves forward in society and take their due place in politics and in the councils of our nation. All concerned agree that such a step is greatly to be desired; but nobody seems to have had sufficient initiative to start the ball rolling.

Some desultory attempts have been made in a few technical schools to teach "oratory" or "public speaking," and occasionally a college club has been formed for this purpose; but there had been no concerted effort on broad lines made until some four years ago. That move was initiated about the end of 1929 in the University of Michigan, under the direction of Prof. Robert D. Brackett, with the moral encouragement of various faculty members. A local organization for this purpose was formed, primarily through the efficient aid of Prof. F. N. Menefee of the College of Engineering. It was called at first "The Stump Speakers' Society," which name was freely translated into Greek, and the

initial letters, Sigma Rho Tau, adopted as its common designation.

Since its conception in a student society, the movement has increased in scope and dignity; and new chapters have been started in several of the technical schools of the state of Michigan. The present intent of its sponsors and leaders is to establish chapters in all the other states of the Union, thus rendering nation-wide the influence of the organization and the accomplishment of its worthy purpose.

As one of the oldest living American engineers, and as one who has always taken an absorbing interest in the advancement of our beloved profession, I desire to record here my unqualified approval of the aims, objects and proposed *modus operandi* of the Sigma Rho Tau Society, and to recommend its speedy installation in all of the leading American institutions of learning where engineering, architecture or technology are taught.

J. A. L. WADDELL,
Consulting Engineer.

New York, N. Y.,
Jan. 4, 1934.

A Criticism

Sir—You have done as much, if not more, than anyone I know, to injure engineering in general and roadbuilding in particular, through the persistent, habitual and never-ending use of "good news" superlatives that belie the situation. These superlatives are sing-song throughout your magazine and give it a collegiate air that you may deem refreshing but is really disgusting to the engineering profession at large, if some recent comments I have heard are criterions.

If there is any one thing that has made President Roosevelt popular, it is his disposition to tell the truth. "Times are bad," says he. We all know it. We are therefore absolutely behind him while he tries something to improve the situation, and he's always ready with suggestions that contain not one iota of misrepresentation.

Destitute veterans had to congregate in Washington before Hoover would admit that anything was out of the ordinary at all. And I guess before you get some real reading matter into your pages, most of the contractors will have to go into the hands of receivers without much to receive; then, perhaps you'll drop this sing-song good news tone in your pages and do contracting and engineering in general some real good.

The *Wall Street Journal* and a number of other financial papers are too frequently quoting the *Engineering News-Record* for "bull" indications that are misleading as quoted. Comparisons with last year, or any recent year for that matter, should be stopped, and a comparison with normal should be initiated. This information gets into channels that have to do with handling funds, resulting in a crimping of allotments to engineering and highway projects. What papers do you see in the hands of public treasury officials? Financial papers, most of them quoting *Engineering News-Record*, too often about the "greatly increased volume" of this, that and the other type of construction. You ought to make such quotations impossible of abstraction from your columns.

You should also pour on more vinegar about specific projects. Roads remain unpaved while CWA officials wonder what they can find for their men to do.

HENRY LOVERIDGE,
Equipment Dealer.

New York City,
Jan. 23, 1934.

Engineer's Obligation to Client

Sir—Reference is made to the letter of Carl Weber in your issue of Dec. 7, 1933, regarding the engineers' code.

I find much in this letter with which I can agree and particularly his statement that "The engineer's first and uppermost obligation is to safeguard the interests of his clients," and his further statement that "This implies the duty that the engineer shall open every door and channel to progress and competitive design, so that the client may get the full benefit of all advantages and improvements that are available for his project at the time." What Mr. Weber says of the engineer applies with equal force to the architect.

On public work particularly there is pronounced antipathy to anything that departs from the beaten path. Alternate designs are prohibited or frowned upon regardless of economic and practical advantages. "We have our own organization to do this work" is a stock answer to any suggestion that a saving in cost might be made by the adoption of an alternate design. The contracting fraternity does not as a rule take kindly to alternates. It means more work in bidding jobs.

Naturally it means extra work for the architect, engineer and contractor to give consideration to alternates. There is a limit to the amount of time that can reasonably be devoted to analyzing and considering alternates. Many of them can be eliminated after a short study, without asking for competitive bids—assuming of course that the architect or engineer in charge of the project is qualified to make comparative estimates.

On the other hand, how can we have progress unless full and careful consideration is given to all improvements in designs and materials and equipment applicable to the problems in hand? It is very definitely the duty of public officials to encourage progress. Our government should aid and encourage engineers and scientific men in every reasonable way. By what process of sound reasoning can the government issue patents to protect the rights of inventors and then rule out the use of all patented articles in its specifications, regardless of the fact that all bidders on the work have the right to use the article upon the same terms?

I see no good reason why any competent architect or engineer should be barred from using the services of specialists provided he assumes the responsibility for this service and provided the one supplying such service is properly compensated therefor.

I do object most seriously to contractors, material men and equipment people assuming the rôle of architects or engineers in responsible charge of construction work. The owner, whether a public body or a private individual or corporation, should be compelled by law to employ competent and qualified architects or engineers (or both) at proper fees (minimum rates to be fixed by code), to take charge of and be responsible for the safe and proper design and construction of the work. This is manifestly in the best public interest, and in accordance with sound business principles.

To talk about "free service" is idle. Service of any kind is not free. It is and must be paid for, by some one and in some way. To allow a client to think he is getting free service is unprofessional. He pays for it in the price of the work. Suppose he does. There is nothing wrong about that provided his architect or engineer tells him so. When such service is accepted, it is the business of the architect or engineer to satisfy himself that it is included in accordance with correct engineering principles and that the designs are adequate and will perform as represented, and to check and approve them and see that they are properly installed in the work.

There is no justification for any architect or engineer to take the position that he must design everything that goes into the job. If he can benefit his client by adopting some special or patented device or design for some part of the work, he certainly owes it to his client to do so.

Let us have an end to quibbling and get down to brass tacks. Engineers are to be employed to do engineering work and to be properly compensated therefor. Professional engineers representing the owner are to be in charge of and responsible for all engineering construction, and they are to be properly compensated therefor. In return, they are to render full, conscientious and complete service. Contractors, material and equipment men are not professional engineers in the sense in which the term is used in this letter. They have no right to usurp the position of the professional engineer, but they have a very definite right to sell their services, materials and equipment, and should be given fair and impartial consideration by the architect and (or) engineer who is in charge of the project.

Minneapolis, Minn.,
Dec. 19, 1933.

WALTER H. WHEELER,
Consulting Engineer.

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EDITOR—F. E. Schmitt. EDITORIAL STAFF—V. T. Boughton, W. G. Bowman, F. W. Herring, C. S. Hill, H. W. Richardson, W. W. De Berard, N. A. Bowers, J. I. Ballard.

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February 15, 1934

Municipal Bond Improvement

SINCE the first of the year the market for municipal bonds has quickened to a remarkable degree. Private investment houses have been showing a great hunger for what they term "prime" municipal issues. As a consequence, municipalities seeking funds at long term are being better favored than they have been for many months past. Both of the classical elements of price determination, demand and supply, have conspired to bring about this condition. The financial operations of the federal agencies during the past year and a half have absorbed many millions of municipal offerings; idle funds in the hands of investors are strongly seeking employment. A situation is thus presented which is distinctly of a hopeful character. Revival of long-term investment is by unanimous agreement of economic authorities one of the most essential factors in a sound business recovery.

PWA Bond Sales

IT IS SIGNIFICANT that the strategic possibilities of the municipal bond situation have been recognized by the federal administration, the PWA having announced that it will offer for sale some of the securities it has acquired. Indeed, the RFC has already acted in the same sense and has sold to private investors some of the bonds of the city of Chicago. Much of the fastidiousness in financial matters displayed by the PWA in passing upon municipal loan applications is explained by this action. With resale in mind as a future possibility, the government has scrutinized municipal bonds in much the same way as the private investor is likely to scrutinize them now. Marketing of its holdings by the PWA will replenish the public-works loan fund which has now been exhausted for some weeks, and, assuming reappropriation by Congress, will make possible further allotments for construction projects. Should the procedure be continued in operation, it is conceivable that in time the part of the fund available for non-federal work would be expended entirely on grants which would not entail repayment. The volume of public works thus made possible of financing would be a powerful thrust against the forces of depression.

The Lighted Torch

THOSE WHO complain that there is too much knowledge and productive skill, and the extremists who go to the length of demanding a vacation in scientific and technical progress so that the world may have time to collect its wits in social and economic matters, have found no hearing among the men whose lives are devoted to carrying on research. These men know that only the continued advance of knowledge provides the inspiration which distinguishes constructive effort from mere drudgery. It is fortunate that neither the industry laboratory nor the college research institution has listened to the preachings of discouragement; their fruitful research has continued even through the most depressing experiences. Only part of the product has as yet come to general knowledge, but a large total of progress has been achieved. Much of the inspirational effect is therefore still to come, particularly as to the research work of industries. The work of the colleges is a more immediate source of inspiration, for, being less immediately directly centered on tangible profit, it is better suited to early reporting, and the stimulus of work and achievement at one institution acts promptly to animate the effort of others. For this reason an account of current work like that of Lehigh reported this week has great constructive possibilities. Similar accounts of work done elsewhere are sure to strengthen the effect.

Research Accomplishment

TRANSLATION of research into practical rules of construction has been remarkably rapid in the instance of the cement-penetration macadam investigations described in this issue. By these studies a type of construction whose procedures had been purely empirical has been put on a rational basis. The builder of a cement-penetration road, through the constants now established, can specify as accurately for the qualities desired as he can for concrete produced under modern weight-control of aggregates and water. The tests have dispelled the old belief that success with cement-macadam demanded primarily an aggregate of hard and tough stone. Instead, the penetration-macadam roadbuilder is shown by the tests that he may select from the whole range of aggregates used in concrete and yet secure sound and stable cement-penetration work. For constructive value the cement-macadam studies described in this issue rank with the tests of vibrated concrete as the outstanding research developments of the past year in the use of cement in road surfacing.

Garbage Grinding

ELSEWHERE in this issue there appears a description of the installation at Baltimore for grinding garbage and disposing of it by utilizing the sewer system. The macerated material is carried to the sewage-treatment plant, where it settles out in the sedimentation tank and digests along with the sewage solids. The installation is frankly experimental, and although its operation during the last summer season was quite satisfactory, it is still considered as being on trial. However, an important fact is that the limited experience so far indicates that little trouble is to be expected from deposition in the sewer system or from interference with sewage-plant operation. The significance of the development lies in its great possibilities, should operation continue to prove trouble-free. For a large city tremendous savings in hauling costs could be effected. Expensive destructor plants could be materially decreased in size. And, of equal importance, the noisome features of garbage disposal would be sharply reduced. The operation of this installation during the coming summer season should be carefully watched by all engineers interested in community sanitation as a full-scale experiment in a field where better method is much to be desired.

The Next Move

THE construction industry's code has been signed, and this week the national code authority is to begin its labors. The government has done its part for self-rule of construction; the rest devolves upon the industry itself.

In order that we may clearly appreciate the task thus laid upon construction, let us recall just what it is that the code accomplishes. By defining construction in broadly comprehensive terms and bringing the full scope of its activities under uniform rules of practice, the code potentially creates an integrated industry. Engineer, contractor and subcontractor—and we may hope in due time also the producer of the materials and machines of construction—are joined as industrial partners, under a single, fair and businesslike standard of practice. Heretofore they were individualists; they are now to be cooperators.

The code authority mechanism alone, however, cannot successfully convert individuals into cooperators. Active support of the industry as a whole is essential. The important point to remember is that the authorities and boards set up by the code are the agents not of the government but of the industry itself. It is their assigned duty to act for the industry and to promote its best interests, to the benefit as well of construction's sole client, the public.

* * *

How are these agents of the industry to be informed, guided and supported by their constituency? Manifestly through the operating organizations of the industry. These organizations have become charged by the code with a new responsibility, and a most serious one. It falls to them to bring the facts, conditions and views of their constituent groups to bear on the self-governing process.

It is vital to bear in mind also that a greater duty rests on these industry associations than merely considering and ratifying code authority actions. The stupendous problem of planning the industry's operations, promoting its welfare by study of best service and wide dissemination of the results of such study, and finally of discovering and remedying the weaknesses of the industry, constitute their most weighty responsibility. Little of this can be done by code authorities.

Here lies the importance of at once examining the organization of the industry, and if need be reshaping it. The principal subcontracting groups already have well-knit organizations. The Construction League and the Associated General Contractors, organs of the general interests concerned in Chapters I and II of the code, still lack adequate breadth, however. Fortunately they showed in their meetings at Washington two weeks ago that they are awake to the tasks before them.

* * *

Considering first construction as a whole, and the place of the Construction League, we must recognize that if construction is to assume adequately the responsibility for planning its program of operation it can be only on the basis of better knowledge of its markets, its methods and its own shortcomings. Without such knowledge we can hardly look forward to increased stability, to improved conditions for employer and worker, or to greater efficiency of the industry's operations.

At present, statistical data are almost absent in the general field of construction. The economic background of construction operations as well as the productive value which they create has had little consideration. We do not know how the industry's procedures affect costs and wastes. There is need for study of its financing, the supply and quality of its materials, its economic relation to business activity, and the factors that determine the permanence of construction investment. These questions, entering deeply into the work of each unit of the industry, are beyond the reach of the single members and groups. Obviously, it is for the Construction League to deal with them to determine whether construction is geared effectively to the world's requirements.

But even before this comes the more immediate problem of promoting thorough organization of the industry in such form as the operation of code self-government demands. Wherever the local or regional sub-groups which are charged with formulating the regional collective bargaining agreements of employers and workers require a forum in which the whole industry can cooperate and coordinate, there a broad local construction organization needs to be established, if the integrating effect of the code is to be made a reality.

These comprehensive problems of organizing and then leading the industry naturally fall to the League, principal sponsor of the code and sole national agency for coordinating the elements of construction. The work to be done is incomparably greater than anything the League has undertaken so far and well beyond the scope of its present form of organization. Aggressive attack on the problem is important, for long delay would mean a fatal loss of influence and effect.

* * *

Second of the great agencies which the code calls into action is the Associated General Contractors. This body made a long stride by deciding to extend the membership privilege to all general contractors, down to the smallest housebuilder. The A.G.C. thereby prepared for effective cooperation in administering the contractor's code and put itself in position to perform constructive service on a scale not heretofore attempted, with the small contractor occupying his deserved place in the vital undertaking of stabilizing investment and wealth in works of construction.

When this joining of forces in the contracting industry is closely studied, it will be recognized as having intensely practical objectives. Through amalgamating all elements into a unified group, the A.G.C. will make itself the spearhead of construction development. In so great a task the individual member of the industry must play his part by assuming association membership and duties. He cannot wisely do otherwise, for, whether he joins with his fellows or not, he is under code regulation.

These problems of organization and of energetic attack on the new tasks and difficulties with which construction has to contend are the responsibility of the industry itself. Now that the code has been approved it is industry's next move.

CURRENT NEWS

Municipal Bonds Held by PWA Offered for Sale

THE PUBLIC WORKS Administration has made it known that it will advertise for bids on bonds purchased in financing non-federal projects. Such bonds will aggregate more than $500,000,000 eventually, but only a few millions are available now. It is Administrator Ickes' intention to offer only certain bonds for sale from time to time when market conditions appear favorable. The PWA has received numerous inquiries from life insurance companies and other fiduciary institutions and it is probable that some issues will command a premium when offered for sale.

Proceeds from the sale of bonds will revert to the Treasury under Section 203(a)3 of the National Industrial Recovery Act and th funds, therefore, will not be available to PWA for allotment to new projects unless reappropriated by Congress. The bonds are general obligation and revenue bonds of states, cities, school districts, counties and other public bodies, purchased by PWA, to yield 4 per cent interest. In cases where the bonds of the municipality have a yield higher than 4 per cent the Public Works Administration refunds to the municipality the difference between the interest rate of the bond and 4 per cent.

Bonds not guaranteed

Administrator Ickes has warned that if any bonds sold by PWA are subsequently offered for resale with any statement indicating or implying guarantee by the federal government, such statement will be fraudulent misrepresentation. All bonds purchased by PWA, however, have been approved by recognized bond counsel and every security in PWA's portfolio was examined carefully by experts in its finance and legal divisions prior to execution of the purchase contracts under which PWA acquired ownership. The projects against which they were issued were approved only after the adminstration's examiners had appraised the necessity for them and their financial, legal and engineering soundness.

Marketing will be undertaken through the Finance Division of PWA. The identity of the first bonds to be offered, together with the time for submitting and opening bids and the conditions of sale, will be announced in a few days. Sealed bids will be received and the bonds will be sold to the highest responsible bidder. The administrator will reserve the right to reject any or all bids.

It has been announced that municipalities may repurchase their own bonds at par plus accrued interest. Several cities have withdrawn their applications for loans because of their ability at present to dispose of their bonds on the open market at a slight premium. The PWA pays par for municipal bonds.

Construction Codes Assigned To New Deputy Administrator

Official announcement has been made by NRA of the appointment of B. R. Value to the position of Deputy Administrator in charge of construction codes. Mr. Value reports to George L. Berry, Division Administrator of Division 3, to whom the construction codes were transferred on January 19 soon after the construction code was returned from the White House for revision. Mr. Value has as his assistants Assistant Deputy Administrators F. H. Weed, J. D. Dusenberry, R. N. Campbell, W. Hook, R. V. Giles, and H. O. Locher. This office has 45 construction codes on its docket, not all of which, however, will become chapters to the construction code if accepted and approved. Recently, the codes for Structural Steet and Iron Fabricating Industry and Steel Plate Fabricating Industry were transferred to Deputy Value. These codes have been handled throughout as separate from the construction code.

With Chapter I of the construction code approved, officials of NRA are bending every effort to complete and send through for approval the divisional chapters. Chapter II—General Contractors Division—has been approved by NRA and the President's signature is momentarily expected.

Other chapters must await definite decision relative to the inclusion of minimum rates for skilled labor. It will be recalled that Chief Counsel Donald R. Richberg thought he had settled this question in the negative last December prior to the sending of the basic code and eight divisional chapters without such skilled rates to President Roosevelt on December 22. When the code returned from the White House, this question was temporarily sidetracked while Chapter I—General Provisions—was modified and approved on January 31.

Decision must also be made with respect to the inclusiveness of the definition in several divisional chapters. As originally drawn, such definitions would cover all operations performed by building owners and managers. Contractors within these divisions defend a broad definition as necessary to prevent exploitation of labor and to stop the trend towards direct employer construction or maintenance, which spells the elimination of the contractor.

Work Resumed on Old Contracts For Chicago Sanitary Work

With funds made available by the Public Works Administration, the Sanitary District of Chicago has entered into supplemental agreement with two of the principal contractors on work previously held up for lack of funds whereby the contractors will resume work. One agreement covers a contract with John Griffiths & Son Co. involving the construction of a pumping station for the disposal of sewage, the return pumping of sludge to the point of final disposal, and the installation of blowers for the aeration tanks at the Calumet Sewage Treatment Works. The original contract, let in August, 1931, was for $1,411,398, of which the unearned balance amounts to $1,314,482. Under the new agreement, the contract price on this balance is increased to $1,414,000.

Similarly, a contract with S. A. Healy & Co., let in February, 1931, amounting to $2,700,000 of which $1,232,000 remains unearned has been modified to increase payment for the remaining work to $1,314,000. This contract covers construction of a battery of 36 Imhoff tanks, service tunnel, valves, ejector houses, etc., at the Westside Sewage Treatment Works.

Canadian Bridge Work Discussed at E.I.C. Meeting

AT THE annual meeting of the Engineering Institute of Canada, held in Montreal Feb. 8 and 9, two of the important new bridges in the dominion afforded the subjects for discussion at the technical sessions. A paper of interest related to the federal relief camp work (analogous in many respects to the CCC in the United States) and in addition the business sessions, which occupied the entire first day of the convention, were of stimulating character because of active discussion centering on a proposed complete revision of the by-laws submitted by the institute's council following two years work by committees on development. Among the changes proposed were the substitution of a single sentence for the existing code of ethics, elimination of the grade of associate member and a general broadening of the base of membership eligibility. These changes were opposed by some, particularly among the younger men, on the ground that they permitted, even though they did not necessarily foster, a general lowering of the standards of the society. J. L. Busfield presented the amendments on behalf of the committee that drafted them. After the discussion it was announced that the proposed by-laws together with an opposition amendment would be sent to all corporate members for letter ballot.

Construction council work

The work of the National Construction Council in promoting a program of public works and government aid for private construction was reported upon by J. B. Carswell. This council, composed of representatives of the architectural, contracting, engineering and associated organizations of Canada, was formed for the purpose of providing a coherent voice for the whole

(Continued on p. 244)

Budget Estimates For Public Works Being Prepared

Washington Correspondence

A NEW budget for public works is in preparation in Washington. The Public Works Administration, Corps of Engineers, and other government construction agencies have submitted estimates for new work in the next fiscal year. Closed hearings before the Bureau of the Budget are still in progress. What amount the PWA is allowing for non-federal projects has not been determined. Funds would not become available until July 1 but the appropriation as of that date would permit PWA to continue allotments on a contingent basis.

It is expected that emphasis from now on will be put on federal projects, bearing particularly on flood control, navigation, power and the other beneficial uses of water. President Roosevelt has been requested by Senate resolution, sponsored by Senator Norris, following conferences at the White House, to outline national policy on flood control. The Mississippi Valley Committee which was charged several months ago with the task of defining such a policy has not yet submitted its conclusions to the President.

In presenting the Government's 1935 budget several weeks ago, President Roosevelt expressed his intention to allot $500,000,000 a year for federal public works from now on. Administrator Ickes has stated repeatedly that this is barely sufficient to cover projects to which it is already committed. At the Capitol general interest has shifted from public works to civil works.

When the House on Feb. 5 passed by a vote of 382 to 1, under procedure that barred amendments, the bill appropriating $950,000,000 for direct relief and civil works combined, the bloc that is attempting to raise the appropriation to continue civil works at least until after the November elections, transferred their efforts to rewriting the bill in the Senate. Senators LaFollette and Costigan, abetted by Mayor LaGuardia, are pressing for continuation of the civil works program after May 1. The New York mayor predicts rioting by unemployed labor if CWA payrolls are cut off.

Administrator Hopkins of the CWA points out that the $950,000,000 appropriation may be divided between direct relief and civil works as circumstances seem to warrant but previously he had announced that $350,000,000 would be allotted to carry civil works to a termination May 1.

Chicago Ordered to Stop Dumping Refuse in Old Canal

By court order Chicago has been enjoined from using the old Illinois and Michigan canal as a dump for refuse. Clay holes are ordinarily used but the city found it cheaper to use the canal and has saved about $200,000 during the last year.

Action against the city was brought by the state. The state also demanded that the city remove the material already dumped but this point was not pressed.

San Francisco-Oakland Bridge Making Satisfactory Progress

Work on the Yerba Buena Island crossing of the San Francisco-Oakland Bay Bridge now includes the driving of the two cable anchorage tunnels and grouting operations to consolidate the rock formation over the main tunnel before starting to advance the face. Another progress feature is the completion of sinking piers E-4 and E-5 on the Oakland side of the island. The caissons for these piers have been sunk to final foundation material at depths of 171 ft. and 165 ft. respectively and preparations for cleaning out and placing the concrete seals are under way.

The anchorage tunnels on the island which will extend to a final depth of 164 ft. are 14 x 25 ft. in section at the upper end and increase gradually to a 27 x 40-ft. section at the bottom. One has been sunk to a depth of more than 100 ft. and the other is down more than 25 ft. Because of the rock formation for the first 200 ft. of the main vehicular tunnel, to be driven entirely from the west portal, it was considered advisable to grout above the arch for this distance before the start of driving. Twenty-five 2-in. holes are being drilled and grouted to a depth of 200 ft. around the line of the arch. This operation is expected to reduce the cost and the hazards of driving.

In the west channel crossing, which consists of twin, 2,300-ft. suspension spans and a common anchorage, caisson sinking is under way at two pier sites and the anchorage. The westerly pier built in open cofferdam at the San Francisco pierhead line has been finished. The three caissons are well into the mud bottom with dredging in progress at pier 6 (next to the island) and the anchorage. At pier 6 the cutting edge is about 30 ft. into the mud below a 105-ft. water depth and at the anchorage (pier 4) the bottom of the caisson is more than 30 ft. into the mud with a 60-ft. depth of water. The caisson at pier 3 was the last one to be towed into position.

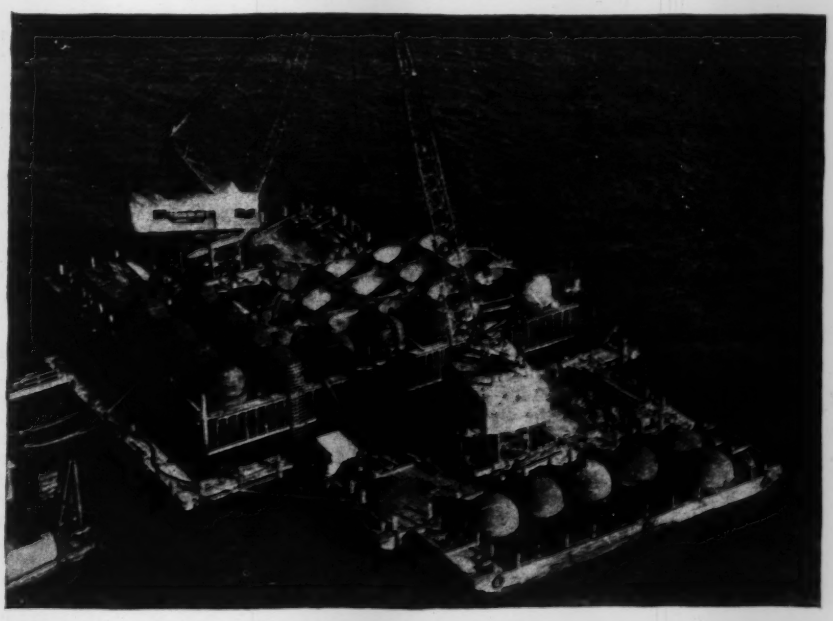
At pier 6 and the anchorage (pier 4), the caissons recently developed a list of a few degrees as the result of slight uneven settlement. At pier 6 the peculiar problem consists in handling a material described as incipient shale, lying in thin laminations, under one edge of the caisson, which is strong until disturbed and then quickly loses its bearing value. At both piers the size and weight of the caissons, the condition of the mud bottom and the heavy lateral forces resulting from swift tidal flow make it necessary to carry on dredging operations slowly and with extreme care. Movement reached about 5 deg. of tilt in both locations. By Feb. 13 the pier 6 caisson had been brought back to level by means of jetting and by forces applied by anchor lines. Pier 4 caisson has recovered more than half its list under careful control with the compressed air domes.

Employment on the project has increased slightly and there are about 2,250 men at work directly on the structure in addition to those employed in various manufacturing operations.

Water Bills in Illinois Carry 2 Per Cent Sales Tax

By a ruling of the Illinois state finance department all water bill must have added to them the 2 per cent retail tax imposed by legislation enacted last year. As Chicago consumers pay $12,400,000 this means $240,000 additional to be collected. The water collection department is just changing its bookkeeping from hand ledgers to machine ledgers. Changes to include the tax computations by machine will be complicated so that much delay is anticipated in getting out bills. Absorption of the tax by the city is not feasible in these times as the water fund now is allocated up to the limit.

SINKING CAISSON for pier 6 which was controlled while being floated into place and during sinking to the bottom by operating the dredging walls as diving bells. View shows domes of diving bells being removed preparatory to dredging.



Canadian Bridge Work Discussed at Montreal Meeting

(Continued from p. 242)

construction industry. A survey made by it revealed a need for a $500,000,000 program of public and private construction. A $51,000,000 federal public works program, distributed equitably among the provinces, was proposed to the dominion government, which is giving sympathetic study to the Council's proposal to substitute construction by normal methods for the large expenditures now going into direct unemployment relief.

F. P. Shearwood, chief engineer, Dominion Bridge Co., was elected president, succeeding O. O. Lefebvre, chief engineer, Quebec Streams Commission. Institute prizes were awarded as follows: The Sir John Kennedy medal to Alexander Joseph Grant, chief engineer, Welland Ship Canal; the Past President's prize to Eric G. Adams; the Gzowski medal to Milton Eaton; the Plummer medal to A. G. Fleming; and the Leonard medal to C. H. Hitchcock. Students' and juniors' prizes were awarded as follows: John Galbraith prize to C. W. Crossland; the Phelps Johnson prize to L. A. Duchastel, Jr.; and the Ernest Marceau prize to R. Boucher.

Technical sessions

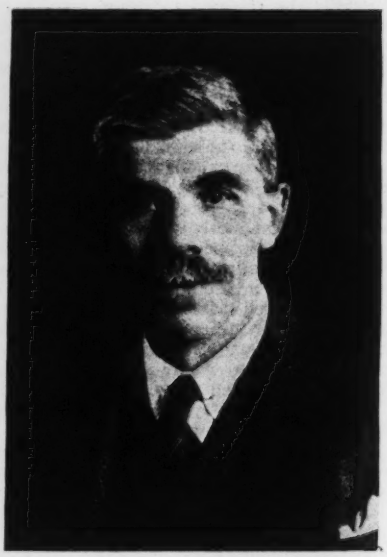
Two bridges of quite different type and location were described in a group of four papers at the technical sessions. In the Broadway Bridge at Saskatoon, Sask., there is represented a multiple-concrete-arch structure while in the second bridge over Lake St. Louis near Montreal, a series of steel deck truss spans is combined with an interesting channel span of so-called continuous tied-arch type. More extended reports on the two bridges will be reserved for a future issue, but it is pertinent to point out that the Saskatoon concrete bridge was carried out as a relief project in an unusually severe winter. Six of the piers were constructed in 11 weeks during which the average temperature was below zero most of the time and was 40 deg. below zero for several days. Unusually complete measurements of temperatures of concrete were kept by Dean C. J. MacKenzie, University of Saskatchewan, who designed the bridge and prepared the paper that was presented. Relief labor was used throughout, and workers were rotated, monthly earnings being limited to $25 to $37.50, depending upon the size of a man's family. Of the $640,000 cost of the bridge, something over half was paid in wages to residents of Saskatoon. The unit concrete cost including falsework, forming, etc., was $10.20 per cubic yard.

In discussing the paper, E. Viens, director, testing laboratory, public works department of Canada, expressed the view that waterproofing of concrete was best and most economically secured by using a liberal amount of cement in the mix, designing, in general, for 3,000 lb. instead of 2,000 lb. concrete. (On the Broadway bridge 6,795 sq.yd. of membrane waterproofing was applied at a cost of $8,154.)

Papers on the Lake St. Louis or Caughnawago bridge were presented by C. F. Draper, of the Lake St. Louis Bridge Corp., who described the survey work, by J. A. Lalonde, chief engineer, A. Janin & Co., contractors for the substructure and by W. Chase Thompson of the Lake St. Louis Bridge Corp., who described the superstructure. A picture and a short description of this structure appeared in *ENR*, Feb. 8, 1934, p. 188.

Relief camps

An unemployment relief scheme, for the care of single homeless men, was described by Major G. R. Turner of the Department of National Defense which is administering the project. The scheme comprises the establishment of camps, the workers carrying out various projects that



F. P. Shearwood, President Engineering Institute of Canada

do not require skilled labor or a considerable amount of machinery. Up to the present time about 35,000 men have been at work clearing and grading airplane landing fields, on forestry work, highway construction, dredging and other work of a "primitive" nature. Machinery and materials have accounted for about 12 per cent of the total expenditure to date. Although the staffs of the military districts are utilized for general administration, the work itself is directly in charge of civilian personnel. Promotions of workmen up to and including the job of foreman are possible, but positions of engineer and assistant engineer are reserved for qualified men. Up to date about 150 engineers have been given work. Engineers and superintendents are paid $100 a month, assistant engineers $80 a month. Workmen receive food, lodging, tobacco, medical care and clothing and $5 a month.

The first project was opened on Nov. 1, 1932, and by Oct. 31, 1933, a total of 101 projects were under way upon which over 2,000,000 man-days of relief had been afforded.

The plan differs from the CCC in the United States in that any single unemployed man is eligible rather than only those under 25 years of age with dependents. The Canadian scheme utilizes a much smaller military personnel. Under the American scheme the relief personnel are enrolled for certain definite periods while under the Canadian scheme the men are free to leave whenever they choose. Major Turner stated that there had been a steady flow of men from the camps back to industry during recent months.

New Applications for P.W.A. Loans Ordered Held Up

PUBLIC Works Administrator Harold L. Ickes has sent instructions to all the state engineers of the PWA to advise local public bodies that no further applications for loans or combined loans and grants will be received by the Public Works Administration. A survey of applications on file at the Washington headquarters and in the hands of the state engineers, according to Mr. Ickes, indicates that there are $3.5 billion of projects on file for which no allotments have been made or for which no money is immediately available because the original PWA fund is exhausted. These applications total nearly 7,000. What per cent of them will be found qualified for the loans has yet to be determined. The state engineers have been instructed to send the Washington office a complete schedule showing what projects are pending. Action by the state officers on these projects is expected to be completed by Feb. 28.

First grant paid out

The first full payment of a grant, representing 30 per cent of the cost of labor and material involved in the project, has been paid by the PWA to Montpelier, Vt. Montpelier has completed a water supply project under an agreement executed on Nov. 22. Salem, Mass., also has completed a project and will receive the full amount of its grant in the near future.

Highway work

The Bureau of Public Roads reports that 586 federal-aid highway projects totaling $14,674,000 have been completed and that 5,723 projects estimated to cost $295,205,000 have been advertised for contract or begun by day labor. At the first of the year, the Bureau of Public Roads reports that 956,000 men were employed on federal and state highway work as follows: Employed directly on the highway project, 362,000; industrial labor, independent industries such as stone quarries, gravel pits, etc., 543,000; administrative and supervisory labor, 51,000. The distribution of the labor employed directly on the projects is as follows:

Public works highway construction supervised by the Bureau of Public Roads	134,862
Federal relief highway construction projects supervised by the Bureau of Public Roads	36,366
Regular Federal-aid highway construction supervised by the Bureau of Public Roads	1,723
Forest, park and public land road construction supervised by the Bureau of Public Roads	1,407
State highway construction with State funds	46,810
State and Federal highway maintenance	140,832
Total Federal and State employment	362,000

Non-federal projects

Allotments totaling $2,450,000 for 46 small non-federal projects were approved by the Federal Works Administration last week. The money for these allotments was made available by rescinding earlier allotments made inactive by the failure of a bond election or a decision of local officials to abandon the work. Reduction of earlier allotments totaling $1,-

West Virginia Court Upholds Financing by Revenue Bonds

The West Virginia Supreme Court has upheld the constitutionality of an act permitting municipalities to borrow federal funds for construction of sewer systems and issuing revenue bonds upon them as security for the loan. The court's decision affirmed a ruling of the Mason County circuit court in a suit brought by a taxpayer against the city of Point Pleasant. The suit attacked the validity of a city ordinance which provided for constructing and financing a self liquidating sewer system.

Army Engineer Appointed Los Angeles CWA Head

Maj. Donald Connolly, a United States Army engineer, has been appointed Civil Works Administration director for Los Angeles, Calif., county, the fourth since the inauguration of the CWA program in the county. He took over the office Feb. 5. Maj. Connolly immediately appointed J. B. Cross of Pasadena, a retired army officer, as executive officer, a position comparable to the office of assistant director. Five other army officers have been assigned by Maj. Connolly to executive posts in the county CWA. Jules Hanique, former engineer for the county CWA, has resumed his office as chief engineer.

366,100 also have added to the available money for other projects. The new allotments and reduced allotments are given in the accompanying table.

Delaware bridge transit line

The Public Works Administration has signed a contract with the Delaware River Joint Commission for a combined loan and grant of $11,900,000 to construct and equip a rapid transit shuttle line across the Delaware River Bridge between Philadelphia and Camden. The line will run from a connection with the subway system in Philadelphia, across the bridge in the space provided for rapid transit lines when the bridge was built, and then through subway to a terminal in the business district of Camden.

State Planning Board Named by New York Governor

Governor Lehman of New York, on Jan. 17, announced the creation of a State Planning Board to cooperate with the National Planning Board set up under the Public Works Administration. The board will consist of from 9 to 15 members, including at least four members of the governor's cabinet.

Bank Awarded Damages for Settlement of Building

The First National Bank of New York, on Jan. 30, was awarded $237,500 for damages to its building at 2-6 Wall St., alleged to have been caused by excavation for the new addition to the Bankers Trust Co. building adioining the First National building on the east. Suit for $551,000 was brought against the Bankers Trust Co. after excessive settlement of the First National building had necessitated its abandonment. The old First National Building, at the northwest corner of Broadway and Wall St., and a landmark of the financial district, was founded on spread footings resting in sand, with footings under joint cross walls between No. 2 and 4, and between No. 4 and 6 Wall St. forming the interior support. In excavating the Bankers Trust addition site, eight underpinning cylinders carried to rock were first placed under the east wall of No. 6 Wall St. Then open excavation of the lot was carried on within steel sheet pile cofferdams. The plaintiff claimed this method was faulty, causing loss of ground under its building, especially under the joint wall between No. 4 and 6 Wall St. Lack of support under this wall caused the old structure to settle and crack, resulting in condemnation by the city building department. Some settlement of the First National building had been noted in the past, once during the excavation for the stock exchange building when a caisson blew in, and again during excavation of the Irving Trust building directly across the street, the latter work being carried on within a full-lot concrete cofferdam. The Foundation Company was contractor on the Bankers Trust addition foundations.

Engineers of Port Body Loaned for Triborough Bridge Project

The services of O. H. Ammann, chief engineer of the Port of New York Authority, and of Mr. Ammann's assistants, have been loaned to the Triborough Bridge Authority to supervise the completion of the Triborough Bridge across the East River at Hell Gate, New York. Mr. Ammann will continue as chief engineer for the Port Authority, including supervision of the construction of the Midtown Hudson Tunnel.

Since the approval by the Public Works Administration of a combined loan and grant of $44,200,000 to the Bridge Authority, the engineering work for the bridge has been carried forward under the direction of Edward A. Byrne, retired chief engineer of the Department of Plant and Structures of the City of New York. Recently, however, the Civil Service Commission held that Mr. Byrne was not eligible for the position of chief engineer of the bridge authority.

U. S. Army Engineers Transferred for Muskingum River Work

Lieut. A. C. Welling, of the district engineers office, U. S. Army, Huntington, W. Va., has been placed in charge of a new office opened at Zanesville, Ohio, and 17 members of the district engineer's staff have been transferred there for work in connection with the flood control and river regulating work in the Muskingum river valley. Recently the Public Works Administration allotted $22,500,000 to the Corps of Engineers to finance the construction of several dams in the river valley.

Governor George White, of Ohio, announced recently that he would ask the special session of the state legislature to appropriate $2,000,000 for the state's share of the undertaking. He also said he would ask the highway department to spend $4,000,000 for the relocation of roads in the district. Start of construction on the project now waits only completion of a satisfactory agreement between the Muskingum Valley Conservancy District and the Public Works Administration.

DETAILS OF PWA LOANS AND GRANTS FOR NON-FEDERAL WORK

Locality	Loan and Grant or Grant	Type	Amount
Bannock County, Idaho (Decrease)	L. & G.	School alterations	$1,100
Jefferson County, Kan. (Decrease)	L. & G.	Roads	6,700
Mena, Ark.	L. & G.	Street paving	42,000
*Youngstown, Ohio	L. & G.	Repairs to dam	106,000
Reading, Pa. (Decrease)	L. & G.	Waterworks	1,355,000
Brunswick County, N. C. (Decrease)	G.	Garage	500
Fisher, Ark.	L. & G.	School	27,208
Cleveland, Okla.	L. & G.	Waterworks	200,000
Humble, Texas	L. & G.	Waterworks	80,000
Humble, Texas	L. & G.	Sewage system	50,000
Buffalo, Wyo.	L. & G.	Water system	43,000
Los Fresnos, Texas	L. & G.	School	4,000
State of Massachusetts, Bridgwater	L. & G.	Refrigerating plant	19,000
Gainesville, Ga.	L. & G.	Jail	128,000
State of Massachusetts	L. & G.	State highway	27,000
Wells, N. Y.	L. & G.	Waterworks	65,000
Hallettsville, Texas	L. & G.	Waterworks	29,000
University of Toledo, Ohio	L. & G.	Buildings	250,000
Centerville, Tenn.	L. & G.	Sewer system	35,000
Buhl, Minn.	L. & G.	Power and water	34,000
Shreveport, La.	L. & G.	Park	125,000
Oconto, Wis.	L.	Hospital	28,000
Spencer, Wis.	L. & G.	Buildings	17,000
Penn Yan, N. Y.	L. & G.	Sewage plant	48,000
Leonard, Texas	L. & G.	Waterworks	5,000
Bryan Co., Okla. (Decrease)	L. & G.	Auditorium	$2,800
State of Massachusetts	L. & G.	Highway	147,000
Rutland, Iowa	L. & G.	School	25,000
Belfast, Ohio	L. & G.	School	16,000
University Park, Texas	L. & G.	Waterworks	121,000
State of Massachusetts, Norfolk	L. & G.	Barn	13,000
State of Massachusetts, Framingham	L. & G.	Police building	41,000
Clarkton, Mo.	L. & G.	School	47,000
State of Massachusetts, Worcester	L. & G.	Hospital exits	138,000
Columbus, Wis.	L. & G.	Sewage plant	17,000
Wisconsin Dells, Wis.	L. & G.	Water and sewer	12,000
Menomonee Falls, Wis.	L. & G.	Sewer system	21,000
Gallatin, Tenn.	L. & G.	Waterworks	30,000
Morgan County, Mo.	G.	School	3,000
State of Massachusetts, Worcester	L. & G.	Standpipe	42,000
State of Massachusetts, Concord	L. & G.	Reformatory	26,000
McPherson, Kan.	L. & G.	Power plant	211,000
Appling, Ga.	L. & G.	Jail	15,000
Richmond, Texas	L. & G.	Waterworks	58,000
Ramsey, Ill.	L. & G.	Waterworks	34,000
State of Massachusetts, Canton	L. & G.	Sewer	71,000
		Total	$2,450,208
		Total Decrease	1,366,100

*Reinstated after recision.

Twin Cities Sanitary Board To Carry Own Insurance

Secretary Harold L. Ickes, administrator of the PWA, today overruled W. N. Carey, Minnesota state engineer for the PWA, and authorized the trustees of the Minneapolis-St. Paul sanitary district to arrange for compensation insurance themselves on the $18,000,000 joint sewer project the two cities are to construct.

The decision of Secretary Ickes ends a two-month controversy that has held up completion of the specifications for bids on first projects of the sewer. With the specifications now completed and approved it is expected, bids can be advertised and contracts let on first projects by March 1.

The item of the workmen's compensation insurance on the project will cost upward of $450,000, it is estimated. The trustees wished to arrange for this insurance themselves and not ask the contractors to do it, believing they could save the district money on the premiums. Carey had declined to approve the plan, saying it was not in accord with PWA practice. A. G. Bastis, member of the board, took the matter up with Senator Henrik Shipstead in Washington, asking him to intercede by bringing the matter directly to the attention of the PWA administrator. This was done and the secretary's statement of approval of the trustees' plan was received today.

Robert Moore of New York, workmen's compensation rating expert, was brought to the city by the trustees to advise them in regard to the insurance. He gave it as his opinion that the Board could save money by arranging for one policy with one company. The board voted unanimously to change the specifications asking all bidding contractors not to add workmen's compensation insurance to the bids, as such insurance will be arranged by the board.

Minnesota Paving Contracts Voided Because of Bidder Prequalification

PAVING CONTRACTS awarded Nov. 10, 1931, by the state highway department of Minnesota for a total of $1,851,461 were declared void on Feb. 10, by Judge Gustavus Loevinger of the Ramsey County District Court, St. Paul. The decision absolves the contractors from the claim of collusive bidding on the part of plaintiff, but holds that the contracts were void because competitive bidding was stifled by the prequalification regulation imposed upon the bidders. These rules limited bidders on projects of 100,000 sq.yd. or more, to contractors who had previously completed that much paving for the state.

The decision absolves Charles Babcock and other state officials from any intentional wrongdoing, by stating: "There is no evidence of any intentional misconduct on the part of any state official. The highway department regulations appear to have been promulgated in good faith, and as soon as it was determined that their effect was not salutary, they were abrogated."

By an agreement between the state officials and the contractors, 20 per cent of the contract price was held back, pending the outcome of the suit. The contractors were paid $1,481,169. The court held that this amounted to attempted ratification of the six contracts then being attacked in court and proceeds to determine the actual value to the state of each contract. This totals $1,461,448, or $19,721 more than the state withheld. Four contractors must reimburse the state and two contractors must receive additional sums from the state.

The judge determined the amount earned by each contractor on each project by evidence submitted by highway officials, expert engineer witnesses and the contractors' figures on sand, gravel and batch hauling costs.

The suit was brought by citizens of St. Paul, Minneapolis, and Northfield, Minn. Defendant contractors were the Central States Construction Co.; Fielding & Shepley, Inc.; Al Johnson Construction Co.; Nolan Bros., Inc.; S. J. Reader & Co.; and the C. F. Sculley Equipment Co. Also named as defendants were C. M. Babcock, state highway commissioner; J. T. Ellison, chief engineer highway department; E. J. Pearlove, state comptroller; C. R. Erickson, state purchasing agent; and Jean Wittich, state budget commissioner. The last three comprised the state commission of administration and fianance, all as of November, 1931.

The position of the State was that of the citizens who brought suit. When the suits were brought in May, 1932, it was alleged that excess profits totalled $600,000. The state attorney general entered the action as intervenor and in the hearing the citizens were thrown out and the State made the sole plaintiff. This was taken to the state supreme court which reversed the district court and ruled that the taxpayers had the right to sue and attacked the bidding regulations, as opening the door to fraud and collusion.

The final suit began October, 1933, and the evidence was completed before Christmas. In its findings the court said, in part:

> A paving contract entered into on behalf of the state, which under the statute is required to be let only after advertising for bids, is void in the secondary sense if the contract is let without requesting bids or if the bidding is restricted by arbitrary, unreasonable, or discriminatory limitations, or if the rules governing the bidding are so framed as to prevent free and full competition.
>
> A paving contract which is void in a secondary sense but is carried out in good faith by both parties, authorizes a recovery by the contractor for the reasonable value of the net benefits received and accepted by the state.
>
> Where a paving contract is void in the secondary sense and payment has been made to the contractors, recovery may be had by the state of any sums paid in excess of the reasonable value of the benefits received by the state. Such recovery may be had from the contractors receiving said sums and from the officers authorizing and directing the disbursement of said sums. The basis for determining the reasonable value of benefits received by the state under a paving contract void in the secondary sense, for which the state is liable, is the lowest sum for which a reasonable bidder would have constructed such improvement, including a reasonable profit to said bidder.

The issues involved in this case were the subject of an investigation in the state senate and house at the 1933 legislative session.

The judge has announced a stay of 40 days, to permit the filing of an appeal to the state supreme court.

SOCIETY CALENDAR

AMERICAN CONCRETE INSTITUTE, Toronto, Ontario, Canada, Feb. 20-22, 193[illegible]

AMERICAN RAILWAY ENGINEERING ASSOCIATION, Chicago, Ill., March [illegible]-14, 1934.

AMERICAN SOCIETY FOR TESTING MATERIALS, Atlantic City, N. J., June 25-29, 1934.

AMERICAN WATER WORKS ASSOCIATION, annual convention, New York, June 4-8, 1934.

SMOKE PREVENTION ASSOCIATION, annual convention, June 19-22, Buffalo, N. Y.

ILLINOIS SECTION, American Water Works Association will hold its annual meeting April 18 and 19 at Peoria. Scheduled are the following subjects: Cast iron pipe joint tests in Milwaukee; amoebic dysentery disclosures and relation to water; pipe corrosion, fire hydrants, new filters at Moline, water works accounting, PWA projects. A. E. Skinner, Chicago, is secretary-treasurer.

Personal

MORGAN G. HAYES has been appointed city engineer of Rochester, N. Y., succeeding C. ARTHUR POOLE who will shortly retire.

JOHN KLORER has been renamed chief engineer of the Orleans Levee Board. Mr. Klorer resigned that position recently to make an unsuccessful race for mayor of New Orleans.

CHAD F. CALHOUN has resumed his former position as engineer for the Henry J. Kaiser Co., Oakland, Calif. Mr. Calhoun recently returned from Panama where he was engineer on a mining exploration expedition.

BENJAMIN MCKEEN, vice-president of the Pennsylvania Railroad in St. Louis, Mo., retired from active service on Feb. 1. Mr. McKeon entered railroad service in 1885 as a draftsman. He became general manager at St. Louis in 1903 and in 1917 was elected fifth vice-president.

HARRY E. JORDAN, sanitary engineer of the Indianapolis Water Co., Indianapolis, Ind., is the official nominee for president of the American Water Works Association for the year 1934-1935. In case no other independent nominations are filed, Mr. Jordan will be considered elected, and will assume office at the fifty-fourth annual convention to be held in New York City during the week of June 4.

DARWIN W. TOWNSEND, acting chief engineer of the Milwaukee and Metropolitan Sewerage Commissions, has resigned to enter private consulting practice as a member of the firm of Consoer, Older & Quinlan, Chicago, Ill. Mr. Townsend has opened an office in Milwaukee. From 1914 to 1922 he was engineer of design for the Milwaukee Sewage Commission. From that time until the present he has been principal assistant engineer and has more recently been acting chief engineer.

S. J. HUNGERFORD has been appointed president of Canadian National Railways. Mr. Hungerford has been associated with railway work throughout his whole career which started in 1886 at the Farnham shops of the old Southeastern Railway, and continued in many parts of Canada, in succeeding grades of the mechanical engineering side of railway work. In July, 1932, he was made acting president of the National system, following the retirement of Sir Henry Thornton.

Obituary

ERCOLE L. SABATINELLI, a contractor of Mendon, Mass., died at the Milford Hospital on February 8 as the result of a motor vehicle accident. He was 54 years of age.

JOEL TORRENCE, civil engineer, died at his home in Edgemere, L. I., N. Y., recently at the age of 68. Mr. Torrence's engineering activities were largely confined to the Pacific Coast region. He came east ten years ago and had been in semi-retirement since.

GEORGE A. M. SCHAEFER, assistant harbor engineer of Baltimore City, died at a Baltimore hospital on February 6. He was 46 years old and had been connected with the engineering department of the city from 1919. During the war he had been an officer in the Corps of Engineers.

FRANK W. KENNEDY, vice-president and general manager of the De Laval Steam Turbine Co., Trenton, N. J., died at his home at Yardley, Pa., on January 24. Mr. Kennedy was born at Pittsburgh, Pa., in 1876 and graduated from Princeton University with a degree in civil engineering in 1898. He became general manager of the De Laval Company in 1908 and in 1916 was elected vice-president.

DAVID LIVINGSTONE MACBEATH, of the United States Bureau of Public Roads, died on January 26, at San Rafael, Calif., following an operation. Mr. MacBeath was born in Chicago in 1874. He began his engineering work in the gold mines of Alaska where he spent the years from 1897 to 1904. After several years in Arizona on irrigation construction and mining work, Mr. MacBeath entered the government service in 1909 with the United States Forest Service. He was transferred to the United States Bureau of Public Roads in 1917. During the last seven years of his service, he was assigned as supervising engineer in Southern California, Southeast Nevada and Arizona north of the Colorado River.

WILLIAM A. CHRISTIAN, civil engineer, U. S. Engineer Office, Chicago District, died February 4 at the age of 64. Graduated in 1893 in civil engineering from the University of Cincinnati his early experience was with the railroads and waterways. In 1914 he came to Chicago as senior roadway engineer for the Interstate Commerce Commission. When work of road and track valuation was completed he went with the Chicago Health Department for a year, and then two years in private practice. In 1898 he had been graduated in medicine from the Cincinnati College of Medicine but did not practice. From 1927 to 1930 he was with the Chicago & Western Indiana Ry. and in 1931 joined the U. S. Engineers staff.

CONSTRUCTION STATISTICS OF THE WEEK

A SLIGHT drop in public work for the week brings the total engineering construction awards down to $21,236,000. This total is doubtless affected by the Lincoln's birthday holiday which made a 4-day week in many parts of the country. This 4-day total is well ahead of the average 1933 February week of $15,128,000 but below this year's previous 4-weeks average of $21,793,000 and average week to date of $23,344,000. Public work dropped from $22,814,000 to $17,424,000. The drop in federal contracts accounted for $4,000,000 and in state and municipal awards, $1,300,000. Private work, which increased from $1,123,000 last week to $3,812,000 this week, was materially aided by the Southern Pacific Railroad contract for $1,750,000 for steel rails.

Highway awards dropped back to $5.8 millions the lowest week this year, sewerage awards registered the second highest week of the year with $1.1 millions, bridge awards totalled $2.5 millions and public buildings $5 millions, the second high week of the year in this classification.

Large awards of the week include: Albion State Training School buildings and sanitary work, New York, $821,000; parcel post building in Boston, $683,000; highway lettings, $681,000 by New Jersey, $431,000 by Texas, $834,000 by Tennessee and $634,000 by North Carolina; Calvert Street bridge, Washington, D. C., $916,000 and Choptank River bridge by Maryland State Road Commission, $948,000. Chicago awarded Section 5 of the West Side Intercepting sewer, $975,000. The Corps of Engineers awarded a $595,000 dredging contract in Arkansas and Lock 10, Mississippi River, $1,363,000.

Sales of state and municipal bonds for new construction purposes increased to $6,378,000, the third highest week this year and 26 per cent over the average week to date. This total includes $5,000,000 Los Angeles waterworks bonds. PWA allotments this week total only $1,084,000 net after deducting reductions in previous allotments. The new capital figure, $7,714,000, is the lowest week of the year and reflects the slowing down of federal allotments. Announcement is made this week that no new applications will be received for PWA loans and grants. Reallocations of earmarked funds will doubtless continue. Announcement is also made that the Public Works Administration is planning to market securities it has taken over on PWA loans.

CONTRACTS
(Thousands of Dollars)

	Weekly Average Feb. 1933	Prev. 4 Weeks	Week Feb. 15 1934
Federal Government	$3,737	$6,707	$3,124
State and municipal	5,873	11,762	14,300
Total public	$9,611	$18,458	$17,424
Total private	5,517	3,325	3,812
Week's total	$15,128	$21,793	$21,236

Cumulative to date:
1933 ..... $139,894 1934 ..... $163,409

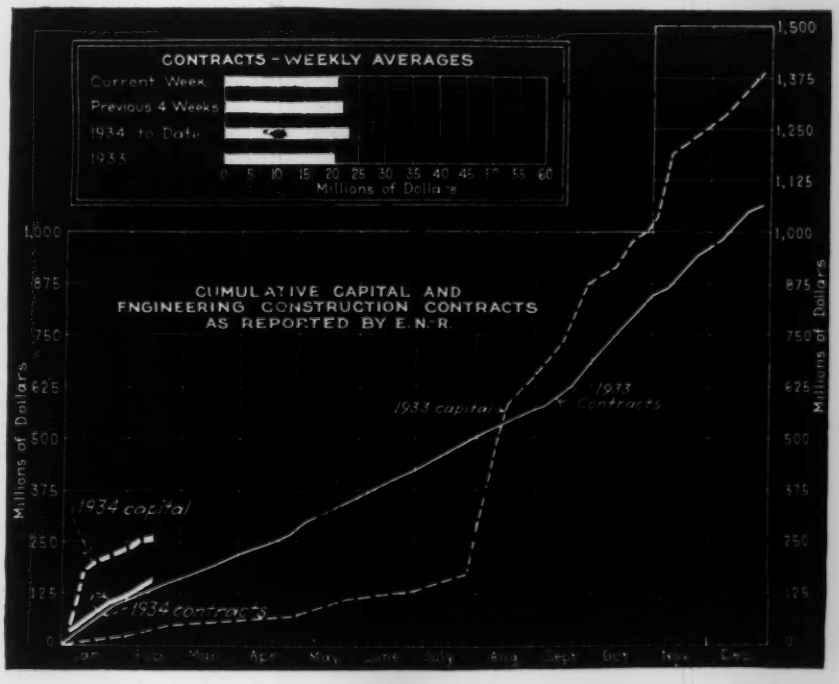
NEW PRODUCTIVE CAPITAL
(Thousands of Dollars)

1934	Week Feb. 15	Cumulative
State and municipal	$6,378	$ 35,411
PWA allotments, S&M	1,056	175,961
Corporate issues	252	10,418
PWA allotments, private	28	36,552
Total, Non-Federal	$7,714	$258,342
PWA allotments Federal Constr.	—	45,734
Total new capital	$7,714	$304,076

Cumulative total to date:
1933 ..... $52,000 1934 ..... $258,342
Rescinded or reduced allotments (from 1933 PWA totals) $34,399

INDEX NUMBER

E.N.-R.-Cost		E.N.-R.-Volume	
February, 1934	194.04	January, 1934	113
January, 1934	191.26	December, 1933	116
January, 1933	159.30	January, 1933	129
1933 (Average)	170.28	1933 (Average)	102
1932 (Average)	156.97	1932 (Average)	127
1931 (Average)	181.35	1931 (Average)	220
1913 (Average)	100		

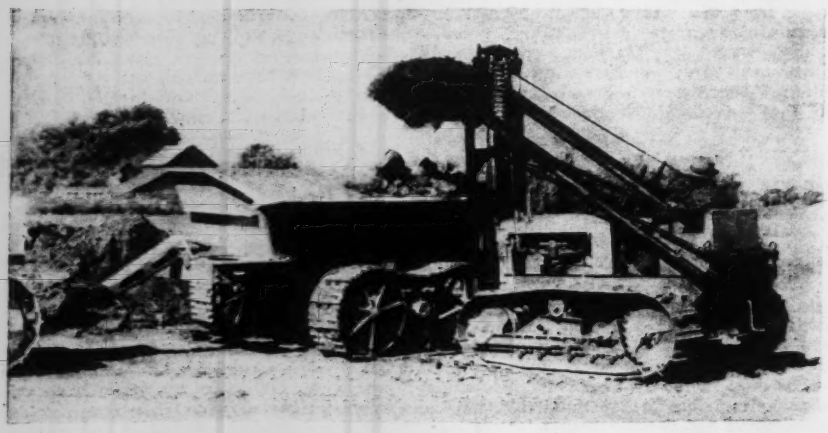


Construction Equipment and Materials

New Front-End Loader For Small Tractor

In collaboration with the Allis-Chalmers Co., the Frank G. Hough Co., Chicago, Ill., has developed a new front end shovel loader for the A-C model "M" tractor. This model tractor is equipped with a special wide-gage long track, and the truck frames are rigidly mounted to eliminate oscillation, thus making it possible to mount the loader solidly. All thrusts are taken on heavy channels supported on the long truck frame. There are five truck rollers per track on this special model which materially spreads the weight of the loader.

The unit is hydraulically controlled and is equipped with counter weights and rear starting crank. The drawbar is clear for use on pulling work.



Front-end shovel loader for use with Allis-Chalmers Model M tractor

New Grab Bucket Makes Level Cut

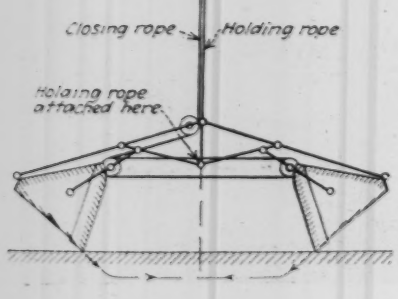
A new departure in grab bucket design has been announced by Priestman Brothers, Ltd., 28 Victoria St., London, SW1, England. The new bucket is called the "Level-Cut" Grab, and is so designed that the jaws are set at the best digging angle at the start of closing, that angle being maintained all the way. The bucket enters the material with a true cutting or shoveling motion and proceeds in this manner to gather its load.

The jaws of the "Level-Cut" Grab are maintained at the desired angle by connecting them, on their inner sides, to the opening arms, thus giving to the cutting edges an approximately parallel motion. This construction also provides that, by suitably fixing the proportions of the bucket framework and positions of the points of articulation, the jaws can be made to cut an approximately straight line while the bucket is held on the holding rope.

The device requires a double-drum crane or hoist for its operation, one drum for hoisting and closing, the other for holding and discharging.

Discharge takes place while the main arms are closed, so that the contents are emptied into a small space.

Jaws of new grab bucket maintain constant angle while closing



New Equipment in Brief

Automobile Governor. The Imperial Devices Co., Chicago, Ill., has announced the Impco governor for cars, buses and trucks. The manufacturer states that the governor controls both engine and traveling speed accurately.

Circular Slide Rule. A metal circular slide rule designed to be carried in the vest pocket has been placed on the market by the Tavella Sales Co., New York, N. Y., under the trade name of Tasco. This rule is made of nickel silver disks with lines and figures etched in black. It is grease- and waterproof and can be washed with soap and water.

Ditching Machines. The Buckeye Traction Ditcher Co. has announced its new Model 11, the smallest of the Buckeye line, having an overall width of only 52 in. It will dig trenches up to 22 in. in width and 5½ ft. in depth. The manufacturer states that when soil conditions are favorable, the trench may be dug at speeds up to 27 ft. per min.

Floor Resurfacing. A new type of floor repair material known as Stonhard resurfacer has been introduced by the Stonhard Co., of Philadelphia, Pa. The material is mixed with sand and cement, and the mortar is laid cold. The manufacturer states that the material will bond to concrete, wood, brick, wood block, asphalt or composition floors. It will not dust, and is sufficiently resilient to be silent.

Self-priming pumps. A new self-priming centrifugal pump has been announced by the Novo Engine Co., Lansing, Mich., which features the "Injecto Prime." By this method the air is exhausted more rapidly from the suction line, by injecting it into the recirculating water flowing at a high velocity. The new line of pumps is built in four sizes, 10,000, 20,000, 40,000 and 90,000 gal. per hour.

Water Paint. A new type of water paint in colors has been developed by the Master Builders Company, Cleveland, Ohio. It is known as "Colored Masterseal" and uses a bituminous emulsion with colors as a base. It may be applied on damp or dry masonry surfaces of every description and, according to the manufacturer, once applied to the surface it quickly hardens and is thereafter unaffected by moisture or efflorescence.

Flasher Signals. Neon illuminating flashing road signs having a low operating cost are the latest developments in safety signals announced by the Lakewood Engineering Co., Columbus, Ohio. The signals are operated by special Willard storage batteries which provide for operation for either 6 or 15 months without adding water or recharging. The battery and flasher mechanism are mounted in the base of the sign, underground. The illumination is produced by Neon tubing behind cutout letters and symbols in the cast aluminum sign face, which are shielded with shatterproof glass.

New Publications

Sheet piling. The Carnegie Steel Co., Pittsburgh, Pa., has issued 25 new loose-leaf sheets describing Carnegie steel sheet piling. The new pages represent modifications in the company's steel sheet piling division for a new standardized series which became effective Nov. 1, 1933.

Thermometers and Pressure Gauges. The Brown Instrument Co., Philadelphia, Pa., has just published Catalog No. 670 describing the new Brown indicating, recording and controlling thermometers and pressure gauges. The catalog comprises 80 pages and is profusely illustrated.

Blowers. Roots-Connersville-Wilbraham, Connersville, Ind., manufacturers of blowers, pumps and meters has just issued a new bulletin 23-B11 devoted to a description of R-C-W equipment as applied in sewage disposal plants. Installations at Peoria and Springfield, Ill. and Salem, Ohio are described.

Floor Plate. A new folder on Inland 4-Way floor plates has just been issued by the Inland Steel Co., Chicago. It describes in 6 pages the detailed advantages of 4-way floor plates, is well illustrated to suggest advantageous use of floor plates, and includes all the size and standard extra data needed by the user.

Rust prevention. Dearborn Chemical Co., Chicago, Ill., has published a 24-page booklet dealing with the problems of rust and corrosion prevention. The booklet illustrates and describes the use of Ox-ide, a chemically compounded rust-preventive. The book deals chiefly with railroad applications because of the fact that the railroad field is a large user of steel.

Carbon Steels. The Carnegie Steel Co., Pittsburgh, Pa., has recently issued a 62-page booklet dealing with steel quality, its control in the basic open hearth process, and what this control means to the users and consumers of steel. Both theoretical considerations and practical procedure as exemplified by the Carnegie plant are covered. Many charts and an equally great number of illustrations, as well as a full and complete bibliography, are included.